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## *VARIATION AND SOME PHENOMENA CONNECTED WITH REPRODUCTION AND SEX.**

### I.

IN the following address an attempt is made to treat the facts of variation and heredity without any theoretical preconceptions. The ground covered has already been made familiar to us by the writings of Darwin, Spencer, Galton, Weismann, Romanes, and others. I have not thought it advisable to discuss the theories of my predecessors, not from a want of appreciation of their value, but because I was anxious to look at the facts themselves and to submit them to an examination which should be as free as possible from all theoretical bias.

Zoology is the science which deals with animals. Knowledge regarding animals is, for convenience of study, classified into several main branches, amongst the most important of which may be mentioned; (1) the study of structure; (2) the study of the functions of the parts or organs; (3) the arrangement of animals in a system of classification; (4) the past history of animals; (5) the relations of animals to their environment; (6) the distribution of animals on the earth's surface. That part of the Science of Zoology which deals

* Address of the president to the Zoological Section of the British Association for the Advancement of Science, Dover, 1899.

with the functions of organs, particularly of the organs of the higher animals, is frequently spoken of as Physiology, and separated more or less sharply from the rest of Zoology under that heading. So strong is the line of cleavage between the work of the Physiologist and that of other Zoologists, that this Association has thought it advisable to establish a special Section for the discussion of physiological subjects, leaving the rest of Zoology to the consideration of the old-established Section, D. In calling attention to this fact, I do not for one moment wish to question the advisability of the course of action which the Association has taken. The Science of Physiology in its modern aspects includes a vast body of facts of great importance and great interest which no doubt require separate treatment. But what I do wish to point out is that it is quite impossible for us here to abrogate all our functions as physiologists. Some of the most important problems of the physiological side of Zoology still remain within the purview of this Section.

For instance, the important and far-reaching problems connected with reproduction and variation are very largely left to this Section, and that large group of intricate and almost entirely physiological phenomena connected with the adaptations of organisms to their environment are dealt with almost exclusively here. Indeed, we may go further, and say that apart altogether from practical questions of convenience, which make it desirable to separate a part of physiological work from the Zoological Section, it is, as a matter of fact, impossible to divorce the intelligent study of structure from that of function. The two are indissolubly connected together. The differentiation of structure involves the differentiation of function, and the differentiation of function that of structure. The conceptions of structure and function are as closely associated as those of matter and force. A zoologist who confined himself to the study of the structure of organisms, and paid no attention to the functions of the parts, would be as absurd a person as a philologist who studied the structure of words and took no account of their meaning. In the early part of this century, when the subject matter of zoology was not so vast as it is at present, this aspect of the case was fully recognized, and one of the greatest zoologists of the century, whether considered from the point of view of modern anatomy, or of modern physiology, was Professor of Anatomy and Physiology at the University of Berlin.

Having said that much as to the various aspects of living Nature, of natural history, if you like, which it falls within the province of this Section to deal with, I may now proceed to the subject of my address. And when I mention to you what that subject is, you will be able to make some allowance for the somewhat commonplace remarks with which I have treated you. For that subject, though it has its important morphological aspects, is in the main a physiological one; at any rate, no study which does not take account of the physiological aspect of it can ever hope to satisfy the intellect of man.

The subject, then, to which I wish to draw your attention at the outset of our proceedings, is the great subject of Variation of Organisms.

As everyone knows, there is a vast number of different kinds of organisms. Each kind constitutes a species, and consists of an assemblage of individuals which resemble one another more closely than they do other animals, which transmit their characteristics in reproduction and which habitually live and breed together. But the members of a species, though resembling one another more closely than they resemble the members of other species, are not absolutely alike. They present differences, differences which make themselves apparent even in members of the same family, *i. e.*, in

the offspring of the same parents. It is these differences to which we apply the term *variation*. The immense importance of the study of variations may be judged from the fact that, according to the generally received evolution theory of Darwin, it is to them that the whole of the variety of living and extinct organisms is due. Without variation there could have been no progress, no evolution in the structure of organisms. If offspring had always exactly resembled their parents and presented no points of difference, each succeeding generation would have resembled those previously existing, and no change, whether backwards or forwards, could have occurred. This phenomenon of genetic variation forms the bedrock upon which all theories of evolution must rest, and it is only by a study of variations, of their nature and cause, that we can ever hope to obtain any real insight into the actual way in which evolution has taken place. Notwithstaading its importance, the subject is one which has scarcely received from zoologists the attention which it merits.

Though much has been written on the causes of variation, too little attention has of late years been paid to the phenomenon. Since the publication of Darwin's great work on the 'Variation of Animals and Plants under Domestication,' there have been but few books of first-rate importance dealing with the subject. The most important of these is Mr. William Bateson's work, entitled 'Materials for the Study of Variation.' I have no hesitation in saying that I regard this work as a most important contribution to the literature of the Evolution theory. In it attention is called, with that emphasis which the subject demands, to the supreme importance of the actual study of variation to the evolutionist, and a systematic attempt is made to classify variations as they occur in Nature. In preparing this book Mr. Bateson has performed a very real service to zoology, not the least part of which is that he has made a most effective protest against that looseness of speculative reasoning which, since the publication of the 'Origin of Species,' has marred the pages of so many zoological writers.

The Variations of Organisms may be grouped under two heads, according to their nature and source: (1) There are those variations which appear to have no relation to the external conditions, for they take place when these remain unchanged, *e. g.*, in members of the same litter; they are inherent in the constitution of the individual. These we shall call constitutional variations, or as their appearance seems nearly always to be connected with reproduction, they may be called *genetic* (congenital, blastogenic) *variations*. (2) The second kind of variations are those which are caused by the direct action of external conditions. These variations constitute the so-called *acquired characters*.

My first object is to consider these two kinds of variations, their nature, their causes and their results on subsequent generations and to inquire whether there are any fundamental differences between them. In this connection it is of particular importance that we should inquire whether acquired modifications are transmitted in reproduction. As is well known, there are two schools of thought holding directly opposite views as to this matter. The one of these schools—the so-called Lamarckian school—holds that they may be transmitted as such in reproduction; the other school, on the other hand, maintains that acquired modifications affect only the individual concerned, and are not handed on as such in reproduction. That the decision of the matter is not only theoretically important, but also practically, is evident, for upon it depends the answer to the question whether mental or other facilities acquired by the laborious exercise of the individual are ever transmitted to the offspring—whether the

facility which the individual acquires in resisting temptation makes it any easier for the offspring to do the same, whether the effects of education are cumulative in successive generations. To put the matter as Francis Galton has put it, is nature stronger than nurture, or nurture than nature?

We have then two kinds of variation to consider: (1) genetic variation, (2) acquired modification. It is the former of these—namely, genetic variation—with which I wish primarily to deal. Let us examine more fully the mode of its occurrence.

GENETIC VARIATION.

Organized beings present, as you are aware, two main kinds of reproduction, the sexual and the asexual. These two kinds of reproduction present certain differences, of which the most important, and the only one which concerns us now, is the fact that genetic variation is essentially associated with sexual reproduction, and is rarely, if ever, found in asexual reproduction. In other words, whereas the offspring resulting from asexual reproduction as a rule exactly resemble the parent, they are always different from the parents in sexual reproduction. I am aware that I am treading on disputed ground. You will observe that I do not make the assertion that asexually produced offspring *always* exactly resemble the parent, and never present genetic variations. To say that would be going too far in the present state of our knowledge. Therefore I have put the matter less strongly, and merely assert that whereas asexual reproduction is on the whole characterized by identity between the offspring and the parent, sexual reproduction is always characterized by differences more or less marked between the two; and I reserve the question as to whether genetic variations are ever found in asexual reproduction for later consideration.

This modified form of the statement will, I think, be admitted on all hands, but before going on I will illustrate my meaning by reference to actual examples.

Asexual reproduction is a phenomenon comparatively rare in the animal kingdom, and when it does occur it is exceedingly difficult to investigate from this particular point of view. In the vegetable kingdom, on the other hand, it is quite common. All, or almost all, plants possess this power, and in a very great many of them the result of its exercise can be fully followed out, and contrasted with that of sexual reproduction. Let us follow it out in the potato-plant. The potato can and does normally propagate itself asexually by means of its underground tubers. As you will know, if you take one of these and plant it, it gives rise to a plant exactly resembling the parent. If the tuber (seed as it is sometimes erroneously called) be that of the Magnum Bonum, it gives rise to a plant with foliage, flowers and tubers of the Magnum Bonum variety; if it be the Snowdrop, the foliage, flowers, habit and tubers are totally different from the Magnum Bonum, and are easily identified as Snowdrops. In this way a favorable variety of potato can be reproduced to almost any extent with all its peculiarities of earliness or lateness, pastiness or mealiness, power of resisting disease and so forth. By asexual reproduction the exact fac-simile of the parent may always be obtained, provided the conditions remain the same.

Now let us turn to the results of sexual reproduction—the seeds, *i. e.*, the real seeds, which as you know are produced in the flowers, are the means by which sexual reproduction is effected. They are produced in great quantity by most plants, and when placed in the ground under the proper conditions they germinate and produce plants. But these plants do not resemble the parent. Try the seed of the Magnum Bonum potato and raise plants from it. Do you think

that any of them will be the Magnum Bonum with all its properties of keeping, resisting disease and so forth? Not a bit of it. The probability is, that not one of your seedling plants will exactly reproduce the parents; they will all be different. Again, take the apple; if you sow the seed of a Blenheim Orange and raise young apple-trees, you will not get a Blenheim Orange. All your plants will be different, and probably not one will give you apples with the peculiar excellence of the parent. If you want to propagate your Blenheim Orange and increase the number of your trees, you must proceed by grafting or by striking cuttings, which are the methods by which such a tree may be asexually reproduced. And so on. Examples might be multiplied indefinitely. Every horticulturist knows that variety characterizes seedlings, *i. e.*, sexual offspring, whereas identity is found in slips, grafts and offsets, *i. e.*, in asexual offspring; and that if you want to get a new plant you must sow seeds, while if you want to increase your stock of an old one you must strike cuttings, plant tubers or proceed in some analogous manner.

An apparent exception to this rule is afforded by so-called bud variation, but it is not certain that this is really an exception. In so far as these bud variations are not of the nature of acquired variations produced by a change of external conditions, and disappearing as soon as the old conditions are renewed, they are probably stages in the growth and development of the organism. That is to say, they are of the same nature as those peculiarities in animals which appear at a particular time of life, such as a single lock of hair of a different color from the rest of the hair,* the change in color of hair with growth,† the appearance of insanity or of epilepsy at a particular age. There is nothing more remarkable in a single bud on a tree departing from the usual character at a particular time of life, than in a particular hair of a mammal doing the same thing.

We have seen that, speaking broadly, genetic variation is connected with sexual reproduction, and it becomes necessary to examine this mode of reproduction a little more fully. What is the essence of sexual reproduction, and how does it differ from asexual? What I am now going to say applies generally to the phenomenon whether it occurs in plants or animals. Sexual reproduction is generally carried on by the co-operation of two distinct individuals—these are called the male and female respectively. They produce, by a process of unequal fission which takes place at a part of their body, called the reproductive gland, a small living organism called the reproductive cell. The reproductive cell produced by the male is called in animals the spermatazoon, and is different in form from the corresponding cell produced by the female, and called in animals the ovum. The object with which these two organisms are produced is to fuse with one another and give rise to one resultant uninucleated organism or cell, which we may call the *zygote*. This process of fusion between the two kinds of reproductive cells, which are termed *gametes*, is called conjugation. The difference in structure between the male and female gamete is a matter of secondary importance only, and is connected with the primary function of coming into contact and fusing. The same may be said with regard to the so-called sexual differences of the parents of the two kinds of gametes, and to the powerful instincts which regulate their action. The conjugation of the male and female gamete, or the fertilization of the ovum, as it is sometimes called, consists in the fusion of two distinct masses of protoplasm which are nearly always pro-

* Darwin, *Variation*, Vol. I., p. 449.

† As an example I may refer to the Himalayan rabbit; Darwin, *Variation*, Vol. I., p. 114.

duced by different individuals. In the case of hermaphrodites, the term applied to organisms which produce both male and female gametes in the same individual, there is generally some arrangement which tends to prevent the male gamete from conjugating with the female gamete of the same parent; but this phenomenon is not absolutely excluded, and takes place as a normal phenomenon in many plants and possibly in some animals.

This fusion of the protoplasm of the two gametes gives us a uninucleated organism —for the fusion of the nuclei of the two gametes seems to be an essential part of the process—in which the potencies of the two gametes are blended. The *zygote*, as the mass formed of the fused gametes is called, is formed by the combination of two individualities, and is therefore essentially a new individuality, the characters of which will be different from the characters of both of the parents. This fact, which is not apparent in the zygote when first established, because the parts are hardly distinguishable by our senses, becomes obvious as soon as organs, with the appearance of which we are familiar, are formed. As a general rule this cannot be said to have occurred until what we call maturity has been nearly reached, because we are not familiar enough with the features of immature organisms to detect individual differences. But you may rest assured that such differences exist at all stages of growth from that of the uninucleated zygote till death. How the characters of the two parents will combine in the zygote it is impossible to predict, and the result is never the same even though the conjugations have been between gametes of identical origin. There may be an almost perfect mixture, the blending extending to even quite minute details; or the characters of the one parent may predominate—be prepotent, as we call it—over those of the other; or they may blend in such a way that the zygote offers characters found in neither parent. Or, finally, the features of one parent may come out at one stage of growth, those of the other at another stage. But, however the characters may blend, the product never exactly resembles the parents. The extent to which it differs from them is the measure of the variation.

To resume, it will be observed that in the method of reproduction sometimes called sexual, two distinct processes occur. One of these is the real reproductive act, which consists in the production by fission of uninuclear individuals called gametes; the second is the fusion of the gametes to form the zygote. The gametes are of two kinds, and the reason of there being two kinds is intelligible when we consider the parts they have to play. The male gamete is nearly always endowed with locomotive power, and the female gamete is stored with food material to be used by the zygote in the first stages of growth. The destiny of these two uninucleated organisms is to fuse with one another, and so to give rise to a zygote which ultimately assumes the typical form of the species. As a general rule the gametes have but a limited duration * of life unless they conjugate, and this is quite intelligible when we remember that they have no organs, *e. g.*, digestive organs, suitable for the maintenance of life. It is rarely found that they have the power of assuming the form of their parent, unless they conjugate. This never happens in the case of the male gamete (at any rate in animals), and only rarely in that of the female. When it occurs—that is to say, when the ovum develops without conjugation—we call the phenomenon parthenogenesis. Parthenogenesis is found more

*Under favorable conditions they may live a considerable time—*e. g.*, the spermatozoon of certain ants, which are stated by Sir John Lubbock to live in some cases for seven years.

commonly in Arthropods than in other groups, but it may be more common than is supposed.*

In sexual reproduction then, in addition to the real reproductive act, which is the division by fission of the parent into two unequal parts, the one of which continues to be called the parent, while the other is the gamete, there is the subsequent conjugation process. It is to this conjugation process that that important concomitant of sexual reproduction must be attributed, namely genetic variation. We have thus traced genetic variation to its lair. We have seen that it is due to the formation of a new individuality by the fusion of two distinct individualities. We have also seen that in the higher animals it is always associated with the reproductive act.

Let us now take a wider survey and endeavor to ascertain whether this most important process, a process upon which depends the improvement as well as the degradation of races, ever takes place independently of the reproductive act. In the Metazoa, to which for our present purpose I allude under the term higher animals, conjugation never takes place except in connection with reproduction. It is impossible from the nature of the process that it should do so, as I hope to explain later on. But among the Protozoa, the simplest of all animals, it is conceivable that conjugation might take place apart from reproduction, and as a matter of fact it does do so. Let us now examine a case in which this occurs. Amongst the free-swimming ciliated Infusoria it frequently happens that two individuals become applied together, and that the protoplasm of their bodies becomes continuous. They remain in this condition of fusion for some days, retaining however their external form and not undergoing complete fusion. While the continuity lasts there is an exchange of living substance between the two bodies, in which exchange a bit of the nucleus of each participates. It thus happens that at the end of conjugation, when the two animals separate, they are both different from what they were at the commencement; each has received protoplasm and a nucleus from its fellow, and the introduced nucleus fuses, as we know, with the nucleus which has not moved. It would therefore appear that all the essential features of the conjugation process, as we learned them in the case of the conjugation of the gametes in the Metazoa are present, and it is impossible to doubt that we have here an essentially similar phenomenon. The phenomenon differs, however, from the conjugation first described in this interesting and important respect, that the two animals separate and resume their ordinary life. It is true that their constitution must have been profoundly changed, but they retain their general form. I say that the constitution of the exconjugates, as we may call them after they are separated, must be different from what it was before conjugation, but so far as I know no difference in structure corresponding with this difference in constitution has been recorded. I feel no sort of doubt, however, that structural differences, *i. e.*, variations, will be detected when the exconjugates are closely scrutinized and compared with the animals before conjugation, and I would suggest that definite observations be made with a view to testing the point. Here, then, we have a case of conjugation entirely dissociated from reproduction. Other cases of a similar character are known among the Protozoa, though as a general rule the fusion between the conjugating organisms is complete and permanent. Among plants, conjugation is generally associated with repro-

*It may be mentioned as a curious fact that parthenogenesis is rarely found in the higher plants, and, as I have said, is not known for the male gamete among animals.

duction, but not always, for in certain fungi* fusion of hyphæ and consequent intermingling of protoplasm occurs, and is not followed by any form of reproduction. Among bacteria alone, so far as I know, has the phenomenon of conjugation never been observed.

To sum up, we have seen that the phenomenon of conjugation is very widely distributed. Excluding the bacteria, there is reason to believe that it forms a part of the vital phenomena of all organisms. Its essential features are a mixture and fusion of the protoplasm of two different organisms, accompanied by a fusion of their nuclei. It results in the formation of a new individuality, which differs from the individualities of both the conjugating organisms. This difference manifests itself in differences in habit, constitution, form and structure; such differences constituting what we have called genetic variations.

The conjugation of the ovum and spermatozoon in the higher animals, and the corresponding process in the higher plants, are special cases of this conjugation, in which special conjugating individuals are produced, the ordinary individuals being physically incapable of the process. The phenomenon of sex, with all its associated complications, which is so characteristic of the higher animals and plants, is merely a device to ensure the coming together of the two gametes. In the lower animals it is possible for the ordinary organism to conjugate; consequently the phenomenon does not form the precursor of developmental change, and is in no way associated with reproduction. Indeed, in such cases it is often the opposite of reproduction, inasmuch as it brings about a reduction in the number of individuals two separate individuals fusing to form one.

* It must be mentioned, however, that in the case of these fungi the fusion of nuclei has not been observed, nor has it been noticed whether the habit, structure, or constitution of the conjugating plants are altered after the fusion.

### ACQUIRED CHARACTERS.

We now come to the consideration of the second kind of variations—namely, those which owe their origin to the direct action of external agencies upon the particular organism which shows the variation; or, as Darwin puts it, to the definite action of external conditions. These are the variations which I have called acquired variations or acquired characters. This is not a good name for them, but at the present moment, when I am about to submit them to a critical examination, I do not know of any other which could be suitably applied. Later on, when I sum up the various effects of the direct action of external agencies upon the organism, I may be able to use a more suitable term.

The main peculiarities of acquired variations are two in number: (*a*) they make their appearance as soon as the organism is submitted to the changed conditions; (*b*) speaking generally they are more or less the same in all the individuals of the species acted upon. As examples of this kind of variations, I may mention the effect of the sun upon the skin of the white man; the Porto Santo rabbit, an individual of which recovered the proper color of its fur in four years under the English climate;* the change of *Artemia salina* to *Artemia milhausenii*; the increase in size of muscles as the result of exercise; and the development of any special facility in the central nervous system. Among plants, variations of this kind are very easily acquired, by altering the soil and climate to which the individuals are submitted. So common are they, that it is quite possible that a large number of species are really based upon characters of this kind; characters which are produced solely by the external conditions and which

* Darwin, *Variation*, ed. 2, Vol. I., p. 119.

frequently disappear when the old conditions are reverted to.

With regard to these variations, we want to ask the following question: Do they ever last after the producing cause of them is removed, and are they transmitted in reproduction? In a great number of cases they either cease when the cause which has produced them is removed, or if they last the life of the individual they are not transmitted in reproduction. But is this always the case? That is the important question we now have to consider.

But before doing so let us inquire what acquired characters really are. The so-called adults of all animals have, as part of their birthright, a certain plasticity in their capacity of reacting to external influences; they all have a certain power of acquiring bodily and mental characters under the influence of appropriate stimuli. This power varies in degree and in quality in different species. In plants, for instance, it is mainly displayed in habit of growth, form of foliage, etc.; in man in mental acquirements, and so on. But however it is displayed, it is this property of organisms which permits of the acquisition of those modifications of structure which have been so widely discussed as *acquired* characters. Now this power, when closely considered, is in reality only a portion of that capacity for development which all organisms possess, and with which they become endowed at the act of conjugation. A newly formed zygote possesses a certain number of hidden properties which are not able to manifest themselves unless it is submitted to certain external stimuli. It is these stimuli which constitute the external conditions of existence, and the properties of the organism which are only displayed under their influence are what we call acquired characters. They are acquired in response to the external stimuli.

It would appear, then, that every feature which successively appears in an organism in the march from the uninucleated zygote to death is an acquired character. At first the stimuli which are necessary are quite simple, being little more than appropriate heat and moisture; later on they become more complicated, until finally, when the developmental period is over and the mature life begins, the necessary conditions attain their greatest complexity, and their fulfilment constitutes what we call in the higher animals education. Education is nothing more than the response of the nearly mature organism to external stimuli, the penultimate response of the zygote to external stimuli, the ultimate being those of senile decay, which end in natural death. Acquired properties, it will be seen, are really stages in the developmental history. They differ in the complexity of the stimulus required to bring them out. For instance, the segmentation of the egg requires little more than heat and moisture, the walking of the chick the stimulus of light and sound and gravity, the evolutions of an acrobat the same in greater complexity, and lastly the action of a statesman requires the stimulation of almost every sense in the greatest complexity. Moreover, not only are there differences in the complexity of the stimulus required, but also in the rapidity with which the organism reacts to it. The chick undergoes its whole embryonic development in three weeks, a man in nine months; the chick develops its walking mechanism in a few minutes, while a man requires twelve months or more to effect the same end. Chickens are much cleverer than human beings in this respect. There is the same kind of difference between them that there is between the power of learning displayed by a Macaulay and that displayed by a stupid child.

An instinct is nothing more than an internal mechanism which is developed with great rapidity in response to an appropriate

stimulus. It is difficult for us to understand instincts, because with us almost all developmental processes are extremely slow and gradual. This particularly applies to the development of those nervous mechanisms, the working of which we call reason.

Within certain limits the external conditions may vary without harming the organism, but such variations are generally accompanied by variations in the form in which the properties of the zygote are displayed. If the variations of the conditions are too great, their action upon the organism is injurious, and results in abortions or death. And in no case can the external conditions call out properties with which the zygote was not endowed at the act of conjugation.

It would thus appear that acquired characters are merely phases of development; they are the manifestations of the properties of the zygote, and are called forth only under appropriate stimulation; moreover, they are capable of varying within certain limits, according to the nature of the stimulus, and it is to these variations that the term acquired character has been ordinarily applied.

A genetic character, on the other hand, is the possibility of acquiring a certain feature under the influence of a certain stimulus; it is not the feature itself—that is an acquired character— but it is the possibility of producing the feature. Now as the possibility of producing the feature can only be proved to exist by actually producing it, the term genetic character is frequently applied to the feature itself, which is, as we have seen, an acquired character. In consequence of this fact, that we can only determine genetic characters by examining acquired characters, a certain amount of confusion may easily arise, and has indeed often arisen, in dealing with this subject. This can be avoided by remembering that in describing genetic characters account must always be taken of the conditions. For example, the white fur of the Arctic hare is an acquired character, acquired in response to a certain stimulus; while the power of so responding to the particular stimulus when applied at the correct time is a genetic character. Thus a genetic character is a character which depends upon the nature of the organism, while an acquired character depends on the nature of the stimulus.

If we imagine a zygote to be a machine capable of working out certain results on material supplied to it, then we should properly apply the term genetic character to the features of the machinery itself, and the words acquired character to the results achieved by its working. These clearly will depend primarily on the structure of the machinery, and secondarily upon the material and energy supplied to it—that is to say, upon the way in which it is worked.

Variations in genetic characters are variations in the machinery of different zygotes that is to say, in the constitution—while variations in acquired characters are variations in the results of the working of one zygote according to the conditions under which it is worked.

For instance, let us take the case of those twins which arise by the division of one zygote, and are consequently identical in genetic characters, *i. e.*, in constitution. If they are submitted to different conditions, they will develop differences which will depend entirely upon the conditions and the time of life when the differentiation in the conditions occurred. These differences then will be a function of the external conditions, *i. e.*, of the manner in which the machinery is worked, and constitute what we call variation in acquired characters.

### ARE ACQUIRED CHARACTERS TRANSMISSIBLE AS SUCH IN REPRODUCTION?

To return to our question, are the so-called acquired characters ever transmitted

in reproduction? Let us consider what this question means in the light of the preceding discussion. Acquired characters are features which arise in the zygote in response to external stimuli. Now the zygote at its first establishment has none of the characters which are subsequently acquired. All it has is the power of acquiring them. Clearly, then, acquired characters are not transmitted. The power of producing them is all that can be transmitted; and this power resides in the reproductive organs and in the gametes to which the reproductive organs give rise, so that the question must be put in another form. Is it possible by submitting an organism to a certain set of conditions, and thus causing it to acquire certain characters, so to modify its reproductive organs that the same characters will appear in its offspring as the result of the application of a different and simpler stimulus?

For instance, the power of reading conferred by education, the hardness of the hands and increased size of the muscles produced by manual labor: is it possible that these characters, now produced by complex external stimuli applied at a particular period of life, should ever in future ages be produced by the simpler stimuli found within the uterus, so that a man may be born able to read or write, or with hands horny and hard like those of a navvy?

In trying to find an answer to this question let us first of all look into the probabilities of the case, to see if we can relate the question to any other class of phenomena about which we have, or think we have, definite knowledge.

When an organism is affected by external agents the action may apply to the whole organization or principally to one organ. Let us take a case in which one organ only appears to be affected, *e. g.*, the enlargement by exercise of the right arm of a man. Now, although in this case it is only the muscles of the arm which appear at first sight to be affected, we must not forget that the organs of the body are correlated with one another, and an alteration of one will produce an alteration in others. By exercise of the right arm the muscles of that arm are obviously enlarged, but other changes not so obvious must also have taken place. The bones to which the muscles are attached will be altered; the blood-vessels supplying the muscles will be enlarged, and the nerves which act upon the muscles, and probably the part of the central nervous system from which they proceed, will also be altered. These are some of the more obvious correlated changes which will have occurred; no doubt there will have been others—indeed it is not perhaps too much to say that all the organs of the body will have reacted to the enlargement of the arm —but the effect on organs not in functional correlation with the muscles of the right arm will be imperceptible, and may be neglected. Thus the color of the hair, the length and character of the alimentary canal, size of the leg muscles, the renal organs, etc., will not show appreciable alteration. Above all, the other arm will not be affected, or if it is affected the alteration will be so slight as not to be noticeable. Now, we know that homologous parts, whether symmetrically homologous or serially so, are in some kind of close connection. For instance, when one member of an homologous series varies, it is commonly found that other members of the same series will also vary. Yet in spite of this connection which exists between the right and left arms and between the right arm and right leg there is no similar alteration either in the left arm or in the right leg. Now, if parts which from these facts we may suppose to be in some connection are not affected, how can we expect the reproductive organs not only to be modified, but also to be so modified that

the germs which are about to be budded off from them will be so affected as to produce exactly the same character—in this case enlarged muscle, etc.—without the application of the same stimulus, viz, exercise? Thus, while I freely admit that every alteration of an organ in response to external agents will react through the whole organization, affecting each organ in functional correlation with the affected organ in a way which will depend upon the function of the correlated organ, and possibly other organs not in functional correlation in an indefinite way and to a slight extent, yet I maintain that it is very hard to believe that it will have such a sharp and precise effect upon every spermatozoon and ovum subsequently produced that not merely will these products be altered generally in all their properties, but that one particular part of them—and that part of them always the same—will be so altered that the organisms which develop from them will be able to present the same modification on the application of a different stimulus. It is inconceivable; unless, indeed, we suppose that the very molecules of the incipient organs in the germ are more closely correlated with corresponding parts of the parent body than are the homologous parts of the parent body with one another.

Now, to prove the existence of such a remarkable and intimate correlation would surely require the very strongest and most conclusive evidence. Is there any such strong evidence? I think I may fairly answer this question in the negative. The evidence which has been brought forward in favor of the so-called inheritance of acquired characters is far from conclusive. That such evidence* exists I do not deny, but it is all, or almost all, capable of receiving other interpretations.

* For a good statement and discussion of the evidence in favor of this view, see Romanes' *Darwin and after Darwin*, Vol. II. chaps., 3 and 3.

### EFFECT OF CHANGED CONDITIONS UPON THE REPRODUCTIVE ORGANS.

On the other hand, all the certain evidence we have concerning what happens when the reproductive organs are affected, either directly or by correlation, by a change of conditions—and, as we have seen above, they must be affected if there is to be any change in the offspring—tends to show that there is not any relation between the effect produced on the parent and that appearing in the offspring.

The only means of judging whether the reproductive organs are affected by external conditions is by observing any change which may occur in their function. Now, only two such physiological effects of a change of conditions are certainly known; these are (1) the production of sterility or of partial sterility; (2) the production of an increased but indefinite variability in the offspring. With regard to the first of these effects: One of the most common, or at any rate one of the most noticeable alterations in an organism, effected by change in the external conditions, is an alteration of the reproductive system, an alteration of such a kind that organisms which had previously freely interbred with one another are no longer able to do so. One of the most common results of removing organisms from their natural surroundings is to induce sterility or partial sterility. There is no reason to doubt that this sterility or tendency to sterility is, broadly speaking, due to an affection of the reproductive system. In the case of the higher animals, it may in some cases be due to an action upon the instincts, but in the lower animals and in plants we can hardly doubt that it is due to a direct action upon the reproductive organs. Indeed in plants these organs are often visibly affected. Among animals, however, there does not appear to be any satisfactory evidence on the point, and it is not known what organs are affected, whether

it is the actual gametes, or the reproductive glands, or some of the other organs concerned.*

The other result of changed conditions which is certainly known is to induce an increased amount of variability of the genetic kind, though not immediately, often indeed not until after the lapse of some generations. On this point Darwin says: "Universal experience shows us that when new flowers are first introduced into our gardens they do not vary; but ultimately all, with the rarest exceptions, vary to a greater or less extent" ('Variation,' 2, p. 249).† With regard to the variability thus induced, it is to be noticed that it is not confined to any particular organ, nor does it show itself in any particular way. On the contrary, the whole organization is affected, and the variations are quite indefinite.

To sum up the argument as it at present stands: (1) a change in conditions cannot affect the next generation unless the reproductive organs are affected; (2) from a consideration of the facts of the case, it is almost inconceivable that the effect produced upon any organ of a given organism by a change of conditions should so modify the reproductive organs of that organism as to lead to a corresponding modification in the offspring without the latter being exposed to the same conditions; (3) the only effects, which are certainly known, of changed conditions upon the reproductive organs are (*a*) the production of sterility; (*b*) an increase in genetic variability.

* The exact cause of this sterility in the higher animals is a point which specially needs investigation.

† The phenomenon of increased variability following upon change of conditions has most often been observed when the change has been from a state of nature to a state of cultivation. Hence the conclusion has been drawn that the kind of change involved in domestication alone induces variation. But there is no evidence in favor of this view. The evidence shows that change of conditions in itself may induce greater variability.

As far then as our certain knowledge goes, it would appear that a change of conditions may have one or both of the following effects:

(1) A definite change, of the same character or nearly so, in all the individuals acted upon. Such changes may be adaptive or non-adaptive, but they are not permanent, lasting only so long as the change of conditions, or at most during the life of the individual acted upon. They are not transmitted in reproduction, and do not appear in the offspring unless it is submitted to the same conditions. These variations are the direct result of the action of the environment upon the individual, with the exception of the reproductive organs.

(2) Increase in the variations of the genetic kind. These are seen not in the generation* first submitted to the changed condition, but in the next or some subsequent generations. The effect is produced through the reproductive organs. These variations are non-adaptive, and different in each individual.

If the reproductive organs are affected we get an increase in the variations of the genetic kind. These, we have seen, are usually of an indefinite character; they are different in every case, and their nature cannot be predicted from experience. But we still have to ask: Is this a universal rule? Does it never happen that a change of conditions so affects the reproductive organs as to produce a definite non-adaptive change of the same character or nearly so in all the descendants of the individual acted upon? This is the most obscure question connected with the study of variations. If such changes occur, they might

* No doubt the individuals of the generation first submitted to the changed conditions would be affected as regards their reproductive organs, which would be altered in structure, but this has not been made out, though there are indications of such an effect in certain plants.

be cumulative, being increased in amount by the continued action of the conditions. They would be non-adaptive, their nature depending on the constitution of the reproductive cells and having no functional relation to the original stimulus.

As possible examples of such variation, I may recall those variations referred to by Darwin as 'fluctuating variations which sooner or later become constant through the nature of the organism and of the surrounding conditions, but not through natural selection' ('Origin,' ed. 6, p. 176); to the variations in turkeys and ducks which take place as the result of domestication ('Variation,' 2, p. 250); to those variations which Darwin had in his mind when he wrote the following sentence ('Origin,' p. 72): "There can be little doubt that the tendency to vary in the same manner has often been so strong that all the individuals of the same species have been similarly modified without the aid of selection."

It is, however, as I have said, extremely doubtful if variations of this kind really occur. The appearance of them may be caused by the combination of the two other kinds of variation. In all cases which might be cited in support of their occurrence, there are the following doubtful elements: (1) no clear statement as to whether the variations showed themselves in the individuals first acted upon; (2) no history of the organisms when transported back to the old conditions.

Moreover, a general consideration of the facts of the case renders it improbable that such similar and definite genetic variations should often occur at any rate in sexual reproduction. For although the effect upon the reproductive organs may possibly be almost the same in nearly all the individuals acted upon, it must not be forgotten that the reproductive elements have to combine in the act of conjugation, and that it is the essence of this act to produce products which differ in every case.

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(*To be Concluded.*)

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## *THE LANGUAGE OF HAWAII.*

## II.

### V.—Special peculiarities.

*Volubility.*—The language of Hawaii is extremely voluble. The comparative ease with which the same ideas may be repeatedly expressed in a different form, and apparently as new material, is shown by the following incident which happened during my visit.

Owing to the mixed composition of the Hawaiian legislature, it is necessary to employ continually two languages. All speeches in English are immediately translated into Kanaka, and *vice versa*. On this occasion the interpreter innocently exposed a fundamental characteristic of the native tongue in replying to a member. An Hawaiian had spoken possibly ten minutes since his last words were translated. A friend, anxious that nothing of importance should be lost, asked why the interpreter did not perform his duty and give the English-speaking members the benefit of the words just uttered. The reply was: "He has said nothing fresh yet." The speaker had simply repeated in new phraseology the substance of his previous remarks, and so skillfully was it done that the friend, although somewhat conversant with the tongue, was misled by Kanaka volubility.

Here we have a distinguished feature in Polynesian methods of thought. By its very simplicity, its lack of generic terms, and its flexibility, the Hawaiian tongue is capable of almost endless expression of the simplest ideas. As we trace the growth of the language, influenced by the peculiar environment and temperament of the peo-

ple, the causes of its unique construction become apparent. In illustration of this idea we shall add a few remarkable characteristics of Oceanic speech:

*Three Numbers*—They have three numbers: the singular, dual and plural. This appeared also in the parent speech of Western tongues, and was preserved in the Aryan, old Bulgarian, and in (Homeric and Attic) Greek; and however strange in English, is but one of the many traces of an early contact in the primitive tongues.

Throughout all Polynesia, and even as far east as the Indian archipelago, we find that peculiar, but very rational, idea which requires the use of a distinguishing word when the person addressed is included or excluded in the statement made. The rule applies both to the dual and plural numbers.

*Hele maua* means we two went, *excluding* the person spoken to.

*Hele kaua* means we two went, *including* the person addressed.

Of course, the first expression requires the presence of at least three persons; the second admits the presence of only two.

*Hele makou* means that we (myself and party) went, but not you.

*Hele kakou*, we (myself and party) went, and you as well.

*Changed Meanings of Words.*—It is a fact frequently observed that one nation often takes a word from a foreign language and gives it a debased meaning in its own, much in the same spirit that one religion supplants another and makes the gods of the old one the devils of the new. *Apporter* (to carry) in French is transformed into *apportieren* in German and applied to dogs as a hunting term.

Take the word *manger*. With us it is for horses; in French it means to eat, and applies also to men and women. The word saloon here means a low drinking place; in France it is the parlor. These linguistic compliments are mutual between two of the Latin countries of Europe. The French word to speak (*parler*) is used in Spanish to designate one who talks too much and says little of importance (*parlero*). Reciprocally, the Spanish word to talk (*hablar*) serves a similar purpose across the Pyrenees, and a *Hableur* is one with many words and few thoughts, who goes about telling lies. Each nation, by implication, casts a slur on the other. We all know what it is to take French leave. So do the French—only they call the same thing going off, after the English fashion, *s'en aller à l'anglaise*. We speak of the leprosy being a disease of the Hawaiian islands. The Hawaiians call it *mai pake* (Chinese disease). The same principle was exemplified in Europe in the sixteenth century. The Italians called it French. These, in turn, threw it on the Spanish; and so it went. No country was willing to father it.

These facts are cited by way of contrast with what took place in Hawaii. The tendency here was to give words and ideas absorbed through external intercourse an elevated meaning. Their conception of foreigners was one of superiority. Captain Cook was the personification of their God, and he is still spoken of as *Lono*, one of the four deities of Hawaiian mythology. No human being was ever feared or worshipped as he, and notwithstanding the tragic circumstances of his death, the natives could not entirely relinquish the supernatural idea, nor bring themselves to give up the illusion of a reappearance of their Savior, to which many still cling after long association with the whites.

It so happened that words that came to the natives through the medium of beings believed to be associated with the Gods were taken to represent better things than they originally designated.

*Special Descriptive Terms.*—The Hawaiian is a child of nature. Nothing can exceed

the vividness with which natural things are portrayed. Almost every conceivable wind has a special name. *Kona* is a wind from the southwest; *hoolua*, a strong north wind; *ea*, the sea breeze at Lahaina; *ulumano*, a violent wind at night on the west side of Hawaii; *mumuku*, a wind blowing between two mountains; *kiu*, a northwest wind at Hana Kaupo; *hau*, a land breeze that blows at night; and so on almost indefinitely. Notice that special terms are given to local winds. Just how the sea breeze at Lahaina differs from that at other places does not appear; nevertheless *ea* applies to this locality and to none other.

Every day of the month has its special name. They count by nights and not by days. *Po akahi* means the first night, *i. e.*, Monday, *po alua*, the second night, or Tuesday, and so on. There are six different words meaning to carry; ten to express the different ways of standing; twenty that apply to various positions of sitting. This shows with what vivid imagery the Hawaiian describes the actions of everyday life. Here are a few examples of shades of meaning for the word carry:

| | |
|---|---|
| *ḫali*, | to carry, in general. |
| *auamo*, | to carry on the shoulder with a stick. |
| *ka'i ka'i*, | to carry in the hands. |
| *hii*, | to carry, as a child in the arms. |
| *koi*, | to carry on a stick between two men. |
| *haawi*, | to carry on the back, etc., etc., etc. |

When the missionaries came to translate the Bible they met an unexpected difficulty. It was necessary to decide between the ages of Mary and Martha, because it is impossible to speak of two sisters in the Hawaiian language without indicating which is the older. I do not know that anything is said in the Scriptures fixing definitely the relative ages of these two persons. The translators were obliged to decide from the context, in the absence of explicit and positive information on the subject.

The childlike and primitive character of the language is shown in the absence of abstract words and general terms, as also in the continual repetition of syllables. The first words pronounced by our own children are a repetition of two of the easiest sounds, pa-pa, ma-ma. The Hawaiians carry this to excess. Take the word *Humu humu nuku nuku apuaa*. This consists largely of repetitions, and is the name of a small fish considerably shorter than its name as ordinarily written. Here is another fish—*Muku muku wahanui*. However, in this case it suits Hawaiian ideas equally well whether you say Muku muku or Kumu kumu. The mere fact of a transposition of syllables is nothing in a language where there are 20 conjugations and where the verb has nearly 3500 forms.

*Cadence.*—Cadence is one of the prime features in all the South sea dialects. So essential is this considered that the tonic accent must be carried forward when an enclitic is employed. The stress is usually on the penultimate in the word *Lani* (heaven), but with the addition of *la* it falls on *ni*, and we say *ma ka laní-la*. *Ua mokú-la*, already given, is another example.

How much more rhythm is regarded in tropical than in northern languages may be seen by comparing the examples just cited with the Spanish, where they say *déme* for give me and *démelo* for give me it. No matter how many enclitics are employed, the accent is still retained in its original place.

*Mathematical Ideas.*—Examine their system of counting. The unit is four. This arose from taking cocoanuts and fish—two in each hand. After laying aside ten units of four, or forty they turned back and counted another forty. This process was continued for ten forties, which took the name of *lau*. Ten of these made 4000, or *mano;* and so they went on until 400,000 was reached, beyond which they had no conception. This was the old system. The

missionaries introduced the modern way of going to ten (*umi*) then joining this with names previously used, as—

*umikumamakahi*, ten with one, for 11,
*umikumamalua*, ten with two, for 12;

and so on to twenty, which was *iwakalua*. Then the same method was continued, as:

*iwakaluakumamakahi*, twenty with one, etc.

There is no word in any of the Polynesian languages to express the idea of a definite fraction. Many words exist to indicate a part; but an aliquot part—something that is contained an entire number of times in the whole—was entirely beyond their mathematical powers.

*Abundance of Words.*—The peculiar character of the Hawaiian language is shown by the great number of words employed as compared with the Aryan tongues. Sometimes the ratio is three to one. We say, "Forgive our debts as we forgive our debtors." Eight words express the idea in English. Twenty-four must be employed in Hawaiian, since it is necessary to say:

*E kala mai hoi ia makou i ka makou lawehala ana me makou e kala nei i ka poe i lawehala i ka makou.*

A few examples will show how cumbersome in a Polynesian tongue are some of the commonest and simplest terms in English. Take the word *across*. In Hawaiian this is *mai kekahi aoao a i kekahi aoao ae*, making eight words, and no shorter way of rendering the idea exists.

Daily would be expressed by *kela la keia la*, meaning that day, this day; being something akin to the Spanish locution for every other day, *un dia si y otro no*.

*Oratory, Religion, and Poetry.*—Besides the ordinary language of life, there is a style appropriate to oratory and one to religion and poetry. Any one who has heard the Kahuna chant his incantations can never forget the doleful, plaintive tone which invariably accompanies such service.

The Hawaiians are passionately fond of poetry. They have no rhyme or meter in the modern sense, and no conception of the change of the length of feet, nor the shifting of the accent, which lends such a charm to English versification; but they have a style, highly figurative, appropriate to different classes of poetry.

There are, first, religious chants. Then the Inoas or name songs; these were composed at the birth of kings. Then came the dirges, and finally the Ipos or love songs. Here is an example of a dirge composed at the death of Keeaumoku and cited by Alexander in his history of the Hawaiian people. The translation is by Ellis:

Alas, alas, dead is my chief;
Dead is my lord and my friend;
My friend in the season of famine;
My friend in the time of drought;
My friend in my poverty;
My friend in the rain and the wind;
My friend in the heat and the sun;
My friend in the cold from the mountain;
My friend in the storm;
My friend in the calm;
My friend in the eight seas;
Alas, alas, gone is my friend;
And no more will return.

*Imagery.*—Notwithstanding the exceedingly primitive nature of the Hawaiian language, it has been successfully employed to express the abstractions of mathematics, and is found flexible enough to deal with law and theology. Of the three classes of words found in all languages, namely, those expressing sensations, images, and abstract ideas, the Polynesian dialects are most copious in the second. The several dozen words already cited, indicating different positions of the body during activity or repose, give abundant evidence of their love of imagery.

Their vocabulary is exceedingly rich in terms relating to the sea, the sky, and the surf; their cloud terms might well rival in exhaustiveness the scientific nomenclature of the modern student of meteorology.

Almost every stick in a native house bears its special name. Each one of the six houses, that every well-to do Hawaiian was supposed to have, before the advent of the whites, had its appropriate use and name.

These were—

1. The *Heiau*, where the idols were kept.
2. The *Mua*, the eating-house for the husband.
3. The *Noa*, or separate house for the wife.
4. The *Hale aina*, or eating-house for the wife.
5. The *Kua*, or the wife's work-house.
6. The *Hale pea*, or the hospital for the wife.

To fully understand these arrangements we must bear in mind that during the reign of the *tabu*, men and women never ate together under any circumstances. The food of the husband could not be cooked in the same oven used by the wife, and pork and many kinds of fish were absolutely prohibited to females; but they could eat dog and fowl.

The custom of applying a term connected with the position of the sun to designate a locality, common in other countries, finds usage in Hawaii. France has her *Midi*, Spain her *Levante* and *Poniente*, and the Kanakas their *Kau*. Kau means summer or warm season, and is used to designate the most southern province of Hawaii. In the first case we have the name of the hottest part of the day given to the territory, and in the latter the name of the hottest part of the year is so utilized.

*Seat of Moral Powers—Parallel Italian Expressions.*—The Hawaiians supposed that each man had two souls. One died with the body, the other lived on as a ghost, and was known by strange squeaking or whistling sounds (*muki*), like the ghosts which did 'squeak and gibber in the Roman streets.' Polynesian ethics also taught that the seat of the moral powers was in the small intestines. The word *loko*, which means *within*, was applied to the moral state or disposition. This idea was so prominent that large stomachs were cultivated as indicative of great moral strength. The word *papio* was applied to the act of lying face downward with nothing for the belly to rest on for the purpose of enlarging it and thus augmenting the moral powers.

This peculiar thought, after all, is not very far removed from that contained in the Italian expressions, *amico sviscerato*, bosom friend, and *un amore sviscerato*, an intense passionate love—literally a disemboweled love. No doubt the idea came through sources where a belief was held similar to that prevalent in Hawaii. Compare also *Mi ha levato un peso dallo stomaco*, He took a weight off my stomach; likewise the sentence, *Questa nuova vi ferirà nella parte più cara delle vostre viscere.* Besides, there has always been more or less connection, either expressed or implied, between the mind and stomach. It was in the Latin language that the original Greek word *στόμα* changed its meaning from mouth to belly. After this the step was easy from the organs of digestion to those of sentiment, and we find many examples in the Romance languages of this enlarged meaning of the original word. So the idea finds expression not alone in the South seas, but may be found cropping out all along the road of linguistic development, whether it be in Greece or Polynesia.

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*COAL FLORAS OF THE MISSISSIPPI VALLEY.*

The plant remains of the Trans-Mississippian coal field have received but scant notice. Something of their character is found recorded in the writings of Lesquereux, Newberry and others. These, however, are the merest glimpses, and give but faint conception of the actual extent and multiplicity of form that the floras of the coal measures present.

The idea has gained currency that the Carboniferous fossil plants of the Mississippi valley are most meagerly represented. The present note endeavors to point out that this widespread notion is wholly erroneous. In vastness, in great variety, in extensive geological range, in completeness of generic representation, in wealth of anatomical material, the fossil floras of the region are believed to have but few equals.

There are several reasons for the apparent paucity of plant remains in the beds of the coal measures. The preservation of the plants is confined almost entirely to the clay shales and shally sandstones. These readily break down under ordinary weathering influences into soft clays. The most prolific plant bed may be thus destroyed, giving scarcely a sign of its organic content. Even in coal mines the obliteration of whatever fossils exist goes on so rapidly that fossil ferns usually fail to attract notice. Only when the perfectly fresh shales are exploited purposely for their fossils can they be made to give up their botanical records.

Many plant remains are preserved or replaced by iron pyrite and quickly decomposed on exposure. The finest structures, displaying anatomical features in the greatest perfection, are frequently in this condition; but it is only when in the fresh state that outlines and markings of the cells are capable of being studied with satisfaction.

Probably the greatest drawback to the acquirement of a complete knowledge of the fossil floras is the lack of interest shown by local collectors. Few fossil gatherers give any attention whatever to the plants. The Paleobotanists are not given to making systematic collections themselves, but study only those scattered chance specimens in cabinets devoted to other fossil forms. As a result we have no complete plant collections.

From the paleontological literature we get only a faint glimpse of the Trans-Mississippian flora. Outside of a few isolated references the only account of an extensive flora is that of Lesquereux, whose material was obtained by Dr. G. H. Britts, of Clinton, Mo. The Britts' collections have been studied anew by David White, whose recent excellent monograph on the Fossil Plants of Missouri shows only too clearly how prolific may be the coal plants of a single locality and of a single horizon. No indication, however, is given regarding the vast possibilities of this coal district as a field for systematic exploitation along paleobotanic lines.

Attention is called in the monograph to some of the obstacles to accuracy in correlation and especially to the lack of standard paleobotanic sections. If ever there were opportunity of establishing a standard section it is in the Trans-Mississippian coal field. Plant remains occur abundantly in many localities and at many horizons, extending from the very base of Des Moines series, up through Missourian, into the so-called Permian. The monograph on the Missouri fossil floras considers chiefly one locality and one horizon. In Missouri alone there are no less than 150 known localities and 30 horizons for coal plants. In Iowa there are nearly as many more. Kansas likewise offers an equally inviting field. If a single location yields up such prodigious possibilities as Mr. White has demonstrated what may we not expect from the rest of the field?

Of Missouri localities furnishing fossil plants, Rich Hill, Kansas City, Lexington, Versailles, Huntsville, Macon and Moberly afford especially attractive fields for early exploration. Exceptional opportunities for the construction of standard paleobotanic sections are offered in the west-central part of the State. These are easily made in a direction east from Kansas City, along the

Missouri river, and continued in the Missourian series along the same stream north from the city. Or, a direction taken southeast of Kansas City is equally advantageous, besides passing through the Clinton district, and reaching into the old gorges in the Mississippian series which are exposed on the flanks of the Ozarks. Work along these lines, both in the floral and faunal fields were begun by the Missouri Geological Survey in connection with the detailed stratigraphical cross sections, and much valuable material obtained, but the efforts had to be abandoned before the data were complete.

The exposures along the Des Moines and Raccoon rivers, in central Iowa, afford another excellent field for making up a standard paleobotanic section. Plant remains occur in many localities and at numerous horizons. Some exquisite things have been observed. Van Meter affords beautiful ternately divided fern fronds over a yard across. Mud Creek, below the city of Des Moines, furnishes, in profusion, plant-bearing nodules similar to Mazon Creek, in Illinois. Ford supplies structural specimens, showing the wood cells and their workings as perfectly as if they were taken from the living plant. Knoxville has extensive plant beds and the bluffs of the streams in Marion county often have tons of shale-slabs with plants in sight at one time. At one time the Iowa Geological Survey began to get material of this kind together for a report on the coal floras of the State supplementary to the reports on coal deposits. But since the appearance of the first volume of the latter nothing farther seems to have been done regarding the plants.

The main consideration, however, is the fact that the Trans-Mississippian coal field presents for the study of fossil plants a wealth of material unrivalled in the whole country. If standard paleobotanic sections of the region are lacking, it is certainly not because the fossil botanist lacks the material and opportunity to construct them.

Charles R. Keyes.

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*ON THE ZOO-GEOGRAPHICAL RELATIONS OF AFRICA.**

The speaker prefaced his communication by remarking that he had nothing absolutely new to bring forward, but that, inasmuch as some views which seemed to be contrary to evidence had been urged very recently, a presentation of the conflicting evidence was timely, if not necessary. The views in question were broached in 'A Geographical History of Mammals,' by Mr. R. Lydekker, and the address of the retiring president of the New York Academy of Sciences (Professor H. F. Osborn) published last week in Science (April 13th).

Beaumont's apologue of the shield has its counterpart for the fauna of Africa. It has two sides facing in opposite directions, and it cannot be understood without taking both into consideration. The proposition to combine Africa with Asia, Europe and North America into a realm contrasted with South America and Australia (or even to combine again Africa and India against the others) may apparently be justified if we look only to the present mammalian fauna, but if we revert to the past and consider other classes, we must be led to different conclusions.

The fishes are by far the most instructive in their teaching. Very recent discoveries recorded by Mr. Boulenger add force to their testimony. Those animals represent two very distinct assemblages. On the one side, we have Cyprinids of genera occurring also in India or very closely related to such genera. On the other side, we see numerous species belonging to families having no representatives in India or elsewhere than in tropical America. Such are the Cichlids,

* A communication to the National Academy of Sciences made April 18, 1900, by Dr. Theodore Gill.

the Characinids and the Lepidosirenids, which are the most prominent constituents of the African fauna. These families are also equally characteristic of tropical America, but the representatives of the two continents belong to different genera.

The deduction seems to be inevitable that the main element of the piscine fauna was derived from the same source as that of America. The fact that generic differentiation has supervened to such an extent suggests, if it does not prove, that the time that has elapsed since the derivation of the respective faunas is great. Equally inevitable appears to be the fact that the cyprinoid element has been derived from an Asiatic source, and the slight differentiations indicate that the introduction of that element has been comparatively recent.

If we now examine the piscine fauna of Madagascar we find that one of the most characteristic African genera (*Tilapia*) is developed in that island and that there is nothing in that fauna to contradict the evidence of that genus—that it has been derived from Africa or the same main source as the African species.

These views are identical with those promulgated a quarter century ago (in 1875) in the *Annals and Magazine of Natural History*, and then Africa and South America were associated together with Australia in a hemisphere called EOGÆA contrasting with anther named CÆNOGÆA, comprising North America, Eurasia and India. The accumulating testimony of the succeeding years has added to the cogency of the argument.

If we now look at the mammalian fauna with the light thus reflected, we may appreciate facts of an analogous nature, but more obscured or complicated by recent interchanges of faunal constituents.

On the one hand are numerous and conspicuous mammalian types congeneric or closely related to Eurasian or Indian forms. On the other hand are many smaller and less obtrusive mammals peculiar to the continent and without any near relatives elsewhere in the present geological epoch.

It has been wisely said that "the final test of a scheme of zoological distribution must be the paleontological test." But the paleontology of Africa has not yet yielded the test. The evidence of paleontology, so far as it goes, points to the origin or development of most of the conspicuous animals of Africa elsewhere than on the continent. It is true that Africa has been declared to be especially the 'center of adaptive radiation during the Tertiary period' of the Proboscideans, as well as of the Hyracoideans. The evidence, for this claim, however, is only negative. At least, so far as the printed record goes, no early remains of Proboscideans or Hyracoideans have been found in Africa, and their former existence there apparently has been assumed because their remains have not been found in better explored lands. The assumption may be right, but it must not be forgotten that it is a pure assumption. Madagascar, however, can not be assumed with strict propriety to be the 'chief centre of adaptive radiation' of all Lemuroideans, inasmuch as that order was formerly widespread, and the great island is rather the last stronghold of the restricted group.

If, as Professor Osborn well urges, it "*is our problem to connect living distribution with distribution in past time and to propose a system which will be in harmony with both sets of facts*," with the facts of distribution of the fishes and even that of mammals in view, the association of the so-called Arctogæan realms is illogical and falsifies the record. Whatever facts a classification may be intended to embody, the African fauna must be isolated. If we wish to express, in our terminology, a former condition of affairs, Eogæa is a term adapted to do so.

## SCIENTIFIC BOOKS.

*The Theory of Electrolytic Dissociation and some of its Applications.* By HARRY C. JONES, Associate in Physical Chemistry in Johns Hopkins University. New York, The Macmillan Company. 1900. Pp. xii + 289. Price, $1.60.

For several decades the dominant field in chemistry has been the study of organic compounds, and it is only within the last ten years or so that the tide has given evidence of turning in other directions. Chemical theory has been developed very largely in its application to organic chemistry and it is partly at least because these theories have proved inadequate in their wider and more general application that attention is being turned more strongly to inorganic chemistry and physical chemistry. There has always been a limited number of chemists who have confined themselves largely to inorganic chemistry, but the great impetus in this direction has come from Mendeleef's generalization of the periodic law, and the consequent necessity of studying closely the relations which subsist between the different elements. So, too, physical chemistry, that is, the study of the physical properties of chemical substances, has always attracted a few investigators. Perhaps the most notable workers have been Kopp, who determined and compared large numbers of physical constants of organic substances, and the founders of thermo-chemistry, Berthelot and Julius Thomsen. But with the work of van't Hoff and Arrhenius was called into being a new physical chemistry, one of the most important fundamental doctrines of which is the theory of electrolytic dissociation, and whose most influential teacher has been Ostwald. The *Zeitschrift für anorganische Chemie* and the *Zeitschrift für physikalische Chemie*, as well as the *Journal of Physical Chemistry* in this country, testify to the activity of the workers in these two newer fields.

The demands of teachers have also occasioned the production in physical chemistry of a very considerable text-book and reference book of literature, much of it far from satisfactory, as is naturally to be expected in a department of science young as yet, and hence in a very immature state. Some of these books attempt a survey of the whole field of the older and the newer physical chemistry, some dwell on the new almost exclusively. The book before us is less ambitious, aiming only to treat of a single, though the most important theory of physical chemistry of to-day. In doing this, however, a view of the relation of this theory to the whole field, and of the newer to the earlier physical chemistry is given. Dr. Jones is to be congratulated upon having written a book which, while brief, is clear and is readable.

The book is divided into four chapters: Chapter I. The earlier physical chemistry, 70 pages; Chapter II. The origin of the theory, 33 pages; Chapter III. Evidence bearing upon the theory, 67 pages; Chapter IV. Some applications of the theory, 112 pages; as far as space goes an excellent balance. In the preface the author states that these chapters seek to answer respectively the questions: "What was physical chemistry before the theory of electrolytic dissociation arose? How did the theory arise? Is it true? What is its scientific use?"

Chapter I. takes up first the work done upon the relations between properties and composition, and properties and constitution. A few pages then outline the development of thermo-chemistry. The next topic is development of electro-chemical theory; the later theories of electrolysis, Hittorf's work on the migration velocity of the ions and Kohlrausch's work on the conductivity of solutions, complete the connection between the older and newer physical chemistry, indeed, these last rather belong to the new. This chapter is completed by the development of chemical dynamics and chemical statics, including the law of mass action, and the work of Willard Gibbs. The treatment of these topics is necessarily brief, but it suffices well to lead up to the main topic of the book.

Chapter II. It is a curious fact that the origin of some of the great ideas of chemistry must be credited to those who were not chemists. The atomic theory, Avogadro's theory, the discovery of the inert gases are examples; so also the theory of electrolytic dissociation owes its origin to the osmotic investigations of a botanist, W. Pfeffer, working in the field of vegetable physiology. Pfeffer in 1877

published a series of quantitative studies of osmotic pressure, using the copper ferrocyanid cell, which was destined to be much used at a later period. At not far from the same time, ideas on the arrangement of atoms in space began to germinate in the mind of van't Hoff. "From this he (van't Hoff) was led to study reaction velocity, and from this the conditions of equilibrium. But closely connected with the problem of equilibrium was that of affinity. He took up, as an example of affinity, the attraction of salts for their water of crystallization, and sought to measure this more directly than had been done." It was at this point that his attention was called to the work of Pfeffer, and after studying concentrated solutions he turned to dilute. In 1887 just ten years after Pfeffer's work, van't Hoff published a paper entitled 'The Rôle of Osmotic Pressure in the Analogy between Solutions and Gases,' and in this shows the application of Boyle's law to dilute solutions. The next step was to show that Gay-Lussac's law also applied to dilute solutions, and finally that these could only be true on the assumption that the law of Avogadro was equally true, that is "that solutions which at the same temperature have the same osmotic pressure, contain in a given volume the same number of dissolved particles."

It soon however became clear that "the osmotic pressures of large classes of chemical substances do not conform to these laws. The exceptions include all the acids, all the bases and all the salts," that is electrolytes, and in all these the osmotic pressure is greater than would be expected. Thus far van't Hoff. The next step is taken by Arrhenius who reasoned that as the anomalous vapor density of ammonium chlorid, etc., was due to the dissociation of the compound into simpler molecules, so in dilute solution the salt is dissociated and this dissociation is into its ions, thus going back to Clausius' theory of electrolysis. In this way came into existence the theory of electrolytic dissociation as advanced by Arrhenius, which is briefly, that all electrolytes when in aqueous solution are dissociated to a greater or less extent into their ions, which are the positive and negative portion of the molecule laden with a charge of electricity.

Such is an outline of the development of the theory as traced in this chapter, much of it in the language of Pfeffer, van't Hoff and Arrhenius, and all of it lucid and logical.

Chapter III. is devoted to a presentation of the evidence for the theory. It is first shown that the physical properties of completely dissociated solutions should be additive, as is the case with dilute solutions of strong salts. Then the evidence from the heat of neutralization is given. The next section is perhaps the most important in the chapter, considering the relations between osmotic pressure, lowering of freezing point, rise in boiling point and electrical conductivity; it is just here that to the older chemists who have not been raised on this theory, the evidence for it appears most convincing, indeed it is the phenomena connected with these points which it is most difficult to account for on any other theory than that of electrolytic dissociation. Experiments to show the presence of free ions, effect of an excess of one of the ions and the relation between dissociation and chemical activity are the next subjects considered and the chapter ends with the effect of water on chemical activity. Numerous examples are given, taken largely from the work of H. Brereton Baker, showing the necessity of the presence of at least a trace of water in many chemical reactions.

For instance, dry chlorin will not act on metallic sodium; dry hydrochloric acid will not act on carbonates; dry hydrochloric acid and ammonia will not unite and dry sodium will not decompose concentrated sulfuric acid. Since the publication of the book, Baker has succeeded in distilling phosphorous in an atmosphere of dry oxygen. The question is now asked, "Why is water essential" and an answer is found "in that water has a very high dissociating power, breaking down the molecules into ions which then react. These facts are just what would be predicted if the theory of electrolytic dissociation is true."

Chapter IV. discusses first the application of the theory of electrolytic dissociation to solutions, and here are brought up a large number of the problems most interesting the physical chemists of to-day. This portion is particularly vivid, so much of it is descriptive of the au-

thor's own work. Here also is given Thomson's theory of the cause of electrolytic dissociation which while offering a simple explanation of the phenomena, has not as yet been fairly tested experimentally. The next section treats of the application of the theory to a physical problem, that of the seat of electromotive force in primary cells, and closely connected with this is a review of Ostwald's work on 'Chemische Fernewirkung.' Then follows the closing section on the application of the theory to biological problems with especial reference to the toxic action of ions.

Such is an outline of the book, whose perusal will well repay anyone who desires to become familiar with the most important phase of modern physical chemistry. It seems ungracious to offer any criticism of a book which limits itself to a definite field and so well carries out its aim, but after reaching the end of the book, one can hardly help feeling that he would like to hear the other side. The author's position is practically that of an advocate, and he makes the best of his case. It is true that he speaks of difficulties, but he does not discuss them or even allude to many of them. He says, indeed, "It has already been mentioned, and stress should be laid upon it, that there are facts to which the theory, as we now conceive it, does not seem to apply. But the evidence in favor of the theory is so overwhelming, in comparison with the few apparent exceptions, that we should examine the latter very closely before concluding finally that they are real exceptions. Without for a moment ignoring the facts for which the theory does not seem to entirely account, the writer believes that the evidence in favor of a great generalization being expressed by the theory of electrolytic dissociation is as strong as in the case of many of our so-called laws of nature. For how many of these apply under all conditions, and are entirely free from exceptions." But we wish the author had added a short chapter on these apparent exceptions, for if one reads his book to gain a knowledge of the theory, one desires to hear at least something of objections raised to it. As far as concerns aqueous solutions the theory seems to present an important and very useful generalization and yet it is not even here free from difficulties. It is also limited in its field in that it does not account for the fact of solubility, nor answer the questions why this salt is soluble, that insoluble; and in that it applies only to electrolytes. Again, as soon as we leave the field of aqueous solutions we realize that the present statement of the theory is too narrow. The work of Franklin on liquid ammonia as a solvent presents many phenomena wholly inexplicable on the theory of electrolytic dissociation, and work with other solvents raises other difficulties.

That such advances have been made along the line of this theory, as yet hardly in its teens, is a source of wonder; but much more remains to be done. The greatest proportion of this work has been confined to aqueous solutions, but it is only by extending it to all manner of solvents that any comprehensive theory of solutions will be reached. This no one realizes more than Dr. Jones, who is applying his work to the alcohols and other solvents, and the same is true of other American chemists. Perhaps after all Dr. Jones' book is the more attractive, and even more useful, because its author has posed less as judge than as advocate.

The typography of the book and its general make-up are excellent, the proof has been very carefully read. One excellent innovation has been partially adopted, that of giving the year in addition to the volume in the references to periodical literature. This, while entailing little additional work upon the author, not only lightens materially the labor of one who is looking up the original literature, but it gives the reader a much more definite chronological idea of the subject-matter. The custom should be uniformly adopted in scientific literature.

The book is provided with a satisfactory index.

Jas. Lewis Howe.
Washington and Lee University.

*An Introduction to Physical Chemistry.* By James Walker, D.Sc., Ph.D. London, Macmillan & Co., Limited; New York, The Macmillan Co. 1900. Pp. x + 355. Price, $2.50.

The author states in the preface that his main object in writing this new work on physical chemistry is to emphasize the important bear-

ing of the principles of the science on the ordinary work of the chemist. The subjects discussed in the book are accordingly selected with this aim in view. Thus by far the larger part of the work is devoted to the consideration of the principles of physical and chemical equilibrium and their applications, and to a discussion of the theory of electrolytic dissociation and the explanations which it offers of the physical and chemical properties of salt solutions, while scarcely ninety pages are occupied by the description of the methods of atomic and molecular weight determinations and by the treatment of the theoretical conclusions derived therefrom in regard to valence, structure, and the relation of properties to atomic weight and to constitution. This is entirely rational from the point of view of the author; for though atomic and molecular weight determinations have great significance historically and theoretically from the fact that upon them is founded the structure theory of organic chemistry, in its comprehensiveness by far the most important theory that physical science has yet developed, it is nevertheless true that this theory is now employed without much reference to the physical relations on which it was originally based, so that a knowledge of the latter is not of great value from a practical standpoint. On the other hand, the electrolytic dissociation theory and the laws relating to equilibrium and reaction-velocity find constant application to the daily work of the industrial, the analytical, and the synthetic chemist.

It is scarcely justifiable to criticise the work adversely on account of the lack of system and logical sequence which it undeniably exhibits, for it is distinctly not intended as a complete, precise, and consistent presentation of the science of general chemistry, but rather as a direct accompaniment of a concrete and highly practical character to the instruction ordinarily given in other branches of chemistry. It is a book which is especially suitable for use in connection with the brief courses on theoretical chemistry which should be given to undergraduate college students. It is also admirably adapted to the needs of the teachers of elementary chemistry and of workers in allied sciences or in industrial chemistry who desire to acquire readily a knowledge of the more concrete and practical side of the subject. It is, nevertheless, the opinion of the reviewer that every thoroughly trained chemist, whether educated at a university or technological institute, should receive a more systematic, logical, precise, and thorough course in theoretical chemistry than that which the present work is intended to give, primarily in order that he may acquire the power of close and accurate thinking, in which students of chemistry are, unfortunately, as a rule, seriously deficient and inferior to students of physics, and secondarily that he may add to his store of specific chemical information a thorough knowledge of the underlying and related general principles—a kind of knowledge which cannot fail to be of great practical value to him, whether he engages in teaching or industrial pursuits. It is, however, unfortunately true that, with the possible exception of the recent work of Nernst, which has not yet been translated and which is too difficult of comprehension except for advanced students, there is no satisfactory text-book to accompany a course of the latter character.

The manner in which the task of the author has been executed is highly satisfactory. The work is written in a readable and unwearying style. The principles are clearly stated, and are always illustrated by concrete examples. The errors to which beginners are liable are especially pointed out. The treatment is a descriptive, not a mathematical one; but the author has not hesitated to employ mathematical expressions where greater clearness is thereby attained. The author, who has supplemented his university instruction in physical chemistry by more than ten years' experience in teaching and research, shows himself throughout the book to be a thorough master of his subject, to have a sound appreciation of the relative importance of the various principles and theories, and to be entirely free from one-sidedness and the desire for radical innovations.

The work is therefore of such a character as to justify the hope that it will mark the beginning of a new epoch in the teaching of general chemistry in this country and in England.

ARTHUR A. NOYES.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

*Essai sur la classification des sciences.* By Edmond Goblot, Docteur és lettres, Professeur au lycée de Toulouse, Ancien élève de l'École normal supérieure. Paris, Felix Alcan, editeur. Bailliere et Cie. 1898.

The excellence of this book, such as it has, lies rather in the way in which the details of the system of classification adopted are worked out than in any fresh or important general view of classification itself, in this respect differing widely from Spencer, whom the book aims largely to correct, and from Comte, whom it aims to complete. For this reason it is not easy to give in a few words a fair outline of this latest serious attempt to classify the branches of human knowledge.

One may say in general of Professor Goblot that his method is historical and critical. He does not attack the problem at first hand, but has continually in mind what has been done already in this field.

The author tells us that be began his study with the problem of immaterial wealth. This led him to study political economy in general; whence he passed to sociology. He discovered that sociology includes many things, logic among the rest, and that it was desirable to form a definite concept of, and to define if possible, this new science. This attempt led him inevitably to a general classification of the intellectual wealth of the race.

Of the two well-known meanings of the word science which we recognize in our English speech, a narrow meaning and a broad one, Mons. Goblot always has in mind the broad one, of which he regards the narrow meaning as a special case. All general knowledge, certain or probable, belongs to science. Philosophy is a part of science: even metaphysics, which, he argues, is either science or nonsense. He will have none of a *chose en soi*. So too there is no valid philosophy of the unknowable. The domain of science is the entire domain of human intelligence and interest. Even the arts are practical or applied sciences and must come into the general scheme.

Savants divide themselves into three groups according as they specialize: (1) mathematics, or (2) the physical and natural sciences, or (3) the moral sciences. Between the last group and the two first groups there is a deep gulf, partly on account of the almost exclusively literary training of historians, economists and sociologists, and partly by their traditions and habits of thought. The first two groups are closely allied.

Everything tends to show the present inferiority of the moral sciences. Although they have occupied the entire field of human interest from early antiquity, they are still poor in results and have neither a fixed object, principle or method. Just now they are making a show of becoming positive, of freeing themselves from metaphysics and taking rank among the sciences of nature. Psychology is about where astronomy was in the time of Tycho Brahe. It has already created for itself a method of observation and a technic and seems ready for a Kepler and a Newton. So psychology essays to become a true natural history of the human soul, and sociology of human society.

So we are coming to have not three, but two divisions of the sciences: (1) sciences of reasoning, deductive and abstract: and (2) sciences of observation, inductive and concrete.

Having maintained the radical opposition of the sciences of demonstration to those of observation there are only two roads to a proof of the fundamental unity of science: (1) the sciences of demonstration (the mathematical sciences) may be regarded as having passed through an early concrete stage to their present form: or (2) the sciences of nature, beginning in the concrete, are now passing forward and in part, have already progressed to the demonstrative stage. Mechanics and mathematical astronomy exemplify this tendency.

Of the two contentions named above the latter is, in point of fact, the one which the author adopts. The sciences of fact tend constantly to become more and more ideal until at last they free themselves from their original empiricism, have for object pure concepts, and proceed by abstract definitions and deductive demonstrations. The demonstrative sciences are the typical sciences: all other knowledge is on the road to this goal.

He does not think that our conception of the universe will become more and more simple, passing finally into one unique and supreme

law. Rather in each order of knowledge there is a unique concept which serves to form all the other concepts of the same order. So he cannot with Comte conceive that the highest science consists in the co-ordination of scientific results. "This new specialty, the specialty of generalization is philosophy." No, says Mons. Goblot, the co-ordination of the results of science is purely literary work. It is the literateur and not the savant who has much to say of the 'majestic unity of sicience.' To specialize generalization is to specialize ignorance.

Historically, philosophy was at first simply science: the whole of science. Then it was science minus a few special sciences which began to be organized. And so this went on, philosophy being continually impoverished by new sciences which were formed from time to time. Philosophy is thus ever the residue: the yet unorganized part of human knowledge.

The book nowhere gives evidence of any considerable acquaintance with any branch of physical or natural science at first hand. It does show much acute thinking and a wide range of reading, especially in what the author would call 'the moral sciences.' Of the 296 pages in the book 169 are occupied with cosmology, biology, and sociology.

E. A. S.

GENERAL.

ANNOUNCEMENT is made by Messrs. Archibald Constable & Company of the preparation of a 'Victoria History of the Counties of England,' to be published in no fewer than one hundred and sixty large octavo volumes. According to the prospectus it "will trace county by county the story of England's growth from its prehistoric condition, through the barbarous age, the settlement of alien peoples, and the gradual welding of many races into a nation which is now the greatest on the globe. All the phases of ecclesiastical history; the changes in land tenure; the records of historic and local families; the history of the social life and sports of the villages and towns; the development of art, science, manufactures and industries—all these factors which tell of the progress of England from primitive beginnings to large and successful empire will find a place in the work, and their treatment be entrusted to those who have made a special study of them."

Mr. H. Arthur Doubleday, F.R.G.S., is the general editor of the whole series, and the plan of arrangement under sectional editors is as follows:

Natural History. Edited by Aubyn Trevor-Battye, M.A., F.L. S., etc. Geology, Paleontology, Flora, Fauna, and Meteorology contributed by specialists.

Prehistoric Remains. Edited by W. Boyd Dawkins. M.A., F.R S., F.S.A.

Roman Remains. Edited by F. Haverfield, M.A., F.S.A.

Anglo-Saxon Remains. Edited by C. Hercules Read, F.S.A., and Reginald A. Smith, B.A.

Ethnography. Edited by G. Laurence Gomme. Dialect and Place Names, Folklore, Physical Types contributed by various authorities.

Domesday Book and other kindred Records. Edited by J. Horace Round, M.A.

Architecture. The Sections on the Cathedrals and Monastic Remains. Edited by W. H. St. John Hope, M.A.

Ecclesiastical History and Political History. By various authorities.

Maritime History of Coast Counties. Edited by J. K. Laughton, M.A.

Topographical Accounts of Parishes and Manors. By various authorities.

History of the Feudal Baronage. Edited by J. Horace Round, M.A., and Oswald Barron.

Family History and Heraldry. Edited by Oswald Barron.

Agriculture. Edited by Sir Ernest Clarke, M.A., Sec. to the Royal Agricultural Society.

Industries, Arts, and Manufactures, Social and Economic History, and Persons Eminent in Art, Literature, Science. By various authorities.

Ancient and Modern Sport. Edited by the Duke of Beaufort.

Bibliographies.

It will be seen that the general scheme of the work is at once comprehensive, scientific, and complete. The history of each county will open with its geology, pass on to its paleontology, and so through the ascending scale of the floral and animal kingdoms until prehistoric man is reached.

THE Scientific Society of Colorado College has just issued Vol. 8 of *Colorado College Studies*, containing the following articles:

'Equations of Motion of a Perfect Liquid and

a Viscous Liquid when Referred to Cylindrical and Polar Co-ordinates,' by Professor P. E. Doudna, 'The Capricorns, Mammals of an Asiatic Type, Former Inhabitants of the Pike's Peak Region,' by Dr. F. W. Cragin; 'Buchiceras (Sphenodiscus) Belviderensis and its Varieties,' by Dr. F. W. Cragin; 'The Number Concept,' by Dr. F. Cajori.

BOOKS RECEIVED.

*Das Tierreich*, 9 Lieferung, *Aves-Trochilidae*. ERNST HARTERT. Berlin, R. Friedländer und Sohn. 1900. Pp. ix + 254. Subscription price, 12 mark.

*Bird Studies with Camera*. FRANK M. CHAPMAN. New York, D. Appleton & Co. 1900. Pp. xiv + 214.

*La spéléologie ou science des cavernes*. E. A. MARTEL. Paris, Georges Carré & C. Naud. 1900. Pp. 126.

*Æther and Matter*. JOSEPH LARMOR. Cambridge, The University Press. New York, The Macmillan Company. 1900. Pp. xxviii + 365. 10s.

## SCIENTIFIC JOURNALS AND ARTICLES.

THE *American Journal of Science* for June contains the following articles:

Method of Studying the Diffusion (Transpiration) of Air through Water, and on a Method of Barometry. C. BARUS.

Separation and Determination of Mercury as Mercurous Oxalate. C. A. PETERS.

Electrical Resistance of Thin Films Deposited by Cathode Discharge. A. C. LONGDEN.

New Meteorite from Oakley, Logan County, Kansas. H. L. PRESTON.

Observations on Certain Well-Marked Stages in the Evolution of the Testudinate Humerus. G. R. WIELAND.

Chemical Composition of Sulphohalite. S. L. PENFIELD.

Phases of the Dakota Cretaceous in Nebraska. C. N. GOULD.

Geothermal Gradient in Michigan. A. C. LANE.

Production of the X-Rays by a Battery Current. J. TROWBRIDGE.

*American Chemical Journal*, May, 1900. "Preparation and properties of the so-called 'Nitrogen Iodide,'" by F. D. Chattaway and K. J. P. Orton. Preparation from iodine monochloride and ammonia; 'The action of reducing agents upon nitrogen iodide,' by F. D. Chattaway and H. P. Stevens. Decomposition with formation in every case of hydriodic acid; 'On certain colored substances derived from nitro compounds,' by C. L. Jackson and F. H. Gazzolo; 'The solution-tension of zinc in ethyl alcohol,' by H. C. Jones and A. W. Smith; 'Notes on lecture experiments to illustrate equilibrium and dissociation,' by J. Stieglitz; 'A contribution to the knowledge of tellurium,' by F. D. Crane. Method of purifying tellurium and detecting small quantities of it; 'The constitution of gallein and coeruleïn,' by W. R. Orndorff and C. L. Brewer; 'Permanganic acid by electrolysis,' by H. N. Morse and J. C. Olsen; 'On chlorine heptoxide,' by A. Michael and W. T. Conn.

J. ELLIOTT GILPIN.

## SOCIETIES AND ACADEMIES.

### SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

AT the meeting of the Science Club of the University of Wisconsin, held May 22d, Mr. J. B. Johnson presented a paper on 'Recently improved Methods of Sewage disposal.' The paper was devoted to a consideration of the principles underlying modern methods of treatment rather than the details of construction of sewage plants. The chemical and the bacteriological methods of sewage disposal were contrasted and the former shown to be too largely an artificial process, since it fails to make use of nature's effective agents—the bacteria—which when afforded suitable conditions change organic wastes into soluble products and finally into the inorganic nitrates and nitrites which constitute so largely the food of plants. The chemical precipitation plants were considered as belonging to a past stage in the development of sanitary science, and wherever installed are now looked upon as an incubus to be got rid of as soon as possible.

The combined septic tank and contact bed method, which was first used at Exeter, England, in 1896, and which is throughout a bacteriological method, Mr. Johnson regards as the most satisfactory solution of the sewage problem. The essential peculiarity of the method is that it affords in the septic tank to which the sewage is first conducted the ideal conditions for the action of the anærobic bacteria whose function

it is to reduce the organic matter by putrefaction to soluble compounds. Further, in the coarsely porous and intermittently aërated contact beds, in which the soluble material from the septic tank is allowed to stand, are afforded the best conditions for the action of the aërobic or nitrifying bacteria. Experience with this method shows that even the solid material from the raw sewage, which in the septic tank is differentiated as a scum at the surface and a deposit at the bottom, is also slowly acted upon by the bacteria so that the quantity in the tank is not appreciably changed after the colonies have become firmly established. In the contact beds also the aërobic bacteria establish their colonies in a few weeks and appear in the form of slime, which adheres to the surface of the cinder or other porous material composing the bed. Before passing from the septic tank to the contact beds the effluent is aërated by allowing it to flow in thin films over weirs. "Perhaps never in the history of engineering," said Mr. Johnson, "has a new process, as revolutionary as this one, established itself so quickly with the highest authorities as has this new and simple method of sewage disposal."

In discussing the paper Mr. H. L. Russell likened the earlier attempts to accomplish the bacteriological purification of sewage in a single process to an attempt to raise the subtropical rice and the temperate to subpolar barley in the same field. Mr. F. E. Turneaure also discussed the paper, emphasizing both the cheapness and the efficiency of the new method. The paper and the discussion aroused much local interest, due partly to the fact that the city of Madison against the advice and the urgent protest of members of the Science Club, recently installed an expensive chemical plant for disposal of its sewage, but has now been compelled to abandon it as a complete failure and has elected Mr. F. E. Turneaure to be City Engineer.

Mr. Johnson's paper will probably be published as a Bulletin of the University of Wisconsin.

Officers of the Club for the ensuing year were elected as follows: Mr. E. A. Birge, President; Mr. C. S. Slichter, Vice-President; Mr. E. R. Maurer, Secretary and Treasurer.

WM. H. HOBBS.

## *DISCUSSION AND CORRESPONDENCE.*

### REPLY TO PROFESSOR KINGSLEY'S CRITICISM.

ONLY about a week ago my attention was called to the criticism by Professor Kingsley of my little book entitled 'Outline of Comparative Physiology and Morphology' in SCIENCE of April 27th. I delayed answering because I was at that time too much absorbed by many duties connected with the close of the academic year to allow my mind to be distracted by unpleasant matters. I am now at comparative leisure and undertake to show that many at least of his criticisms are unjust.

His points of criticism may be classified under several heads:

1. First and most numerous are general statements which are true but not without exceptions. This was unavoidable in a bare *outline* such as the work professed to be. Our distinctions in science are always sharper than in nature. This is especially true in elementary science. If exact details and all exceptions were given we should certainly fail to give a clear outline to be filled in by subsequent study. Under this head come—(*a*) the failure to make exception of Fungi in giving the broad distinction between animals and plants in the nature of their food. If I had attempted absolute exactness I should have been compelled not only to make exception of greenless plants, but to have discussed the economy of carnivorous plants, and the question whether all plants, even the greenest, do not supplement their mineral food with more or less of organic food. And then what would have become of my *Outline?* The very first necessity in an elementary work is to renounce much, very much that we should like to introduce. (*b*) Under the same head comes the statement that animals by virtue of the nature of their food must have a stomach, without mentioning some exceptions among parasites, as the tapeworm. (*c*) In speaking of the general absence of the middle ear in amphibians I did not make exception of Anura. (*d*) In omitting mention of distinct renal organs in Phyla lower than Mollusca. Surely these objections are hypercritical although in some cases especially (*c*) a foot-note might be added giving exceptions.

2. I said the last group may be regarded as

examples of hypercriticism, but there are other objections which are distinctly so. (*a*) I say, the olfactive nerve is specialized for the perception of odors, he objects that the *terminations* alone are thus specialized. This may be true, but is not the termination also included in my general statement? (*b*) I say a muscle is an arrangement for changing nerve-force into mechanical power. He apparently objects, but why he does not say and I cannot imagine. The statement is certainly true. (*c*) He reproaches me for certain important omissions, *e. g.*, the *mesodermal origin of metameres.* Surely this objection implies an attitude of mind wholly inconsistent with the writing of an outline.

3. A few of his criticisms are pure mistakes or else misunderstandings of my meaning. For example (*a*) he quotes me as saying that 'no voice is known below hexapod insects' and cites the stridulation of spiders and crustaceans. I did not say so. I said '*below this department*,' *i. e.*, *arthropods.* (*b*) I state that homologies are not distinctly traceable beyond the limits of a Phylum. The cases of homologies beyond these limits which he mentions are not certainly examples of homology but of analogy, not evidences of common origin but of adaptive modification. But in any case it must be remembered that I was tracing homology only in the clearest cases and as an argument for Evolution. (*c*) He says I omit all mention of branchiæ in Asterias although I mention them in Echinus. Is he sure that there are any such in Asterias? Perhaps they are among the newest things which he accuses me of neglecting.

4. Some of the objections he makes concern points still in doubt, *e. g.*, the function of the pedicillariæ in echinoids. The function I gave, viz, that of carrying food to the mouth, is still held and is not inconsistent with that which he probably had in mind, viz, the cleansing of the body.

5. Besides these there are, I frankly acknowledge, some real mistakes. It would be strange if there were not. For pointing out these I most heartily thank him. I will profit by his criticisms.

But I fear I weary the reader with personal matters which are of little importance. It is with real pleasure therefore that I hasten on to take up the last point, which is one of great interest in the general field of scientific thought.

6. The worst fault which Professor Kingsley finds in my book is '*the recognition* of a *vital force.*' Now this really amuses me. Surely Professor Kingsley must be ignorant of the early history of discussions on this subject or he would be aware that I was myself among the earliest enforcers of the doctrine of 'the correlation of vital with physical and chemical forces and the conservation of energy in the phenomena of living things.' I even suffered somewhat from the odium theologicum on that account. That my contributions to the discussion were not unimportant see the references given below.* The position I held then is so universally acknowledged now that the history of the discussion has lost something of its interest to the present generation. But some would go farther. In the revulsion against the *old idea of vitality* as an independent supra natural force unrelated to the other forces of nature the scientific mind swung too far in the contrary direction, and it become the fashion for scientific men to ridicule even the use of the term *vital force* as the useless remnant of an old superstition and indicating a wholly unscientific attitude of mind; and thus gradually arose an odium scientificum forbidding the use of the term on pain of being thought unscientific. And yet the same men who repudiate life as a force talk serenely of gravity as a force or chemical affinity as a force, or the force of attraction or of inertia, wholly unconscious of any inconsistency in their position. The fact is, all of these stand on the same footing. They are *none* of them forces in the old sense of independent entities—they are *all* of them forces in the sense of *different forms* of the one universal energy, they are all *derivable from and convertible into* one another. They are all different forms of energy, determined by different condi-

**Am. Jour. Sci.*, Vol. 28, p. 305, Nov., 1859; *Phil. Mag.*, Vol. 19, p. 133 and 243, 1860; *Pop. Sci. Monthly* for Dec., 1873; *Carpenter's Physiology*, 7th ed., p. 7; McGee, Fifty Years of Am. Sci.; *Atlantic Monthly* Sept., 1898.

tions, giving rise, each, to its own characteristic group of phenomena, the subject matter of its own peculiar department of science. For convenience we give them names. Now the group of phenomena characteristic of living things is a more peculiar group than any other lower group, and therefore the determining form of energy *better deserves a distinctive name* than any other and lower form.

But some one will say: "vital force is a metaphysical conception and as such has no place in science." If so, then must we banish also all ideas of force, or power, or cause as metaphysical. The fact is, science cannot get on without metaphysical conceptions. We strive in vain to realize a science such as Comte imagined—a mere succession of phenomena following one another like the trooping shadows of a phantasmagoria *without causative nexus between*. Comte repudiated the idea of atoms and of a hypothetical ether as metaphysical ideas, and yet, who can estimate the service done to science by these ideas?

These views I have maintained for the last 30 years. In spite of the odium scientificum I have continued to use the term *vital force*, not indeed in its old sense but in a true rational sense. But the reaction toward a more rational view is now fairly on. It may again go a little wrong. I cannot sympathize entirely with all the recent views on this subject. Some of them seem to smack a little of the old supra-naturalism, but it will come right in the end. Meanwhile, I would commend to the attention of all who, like Professor Kingsley, are afflicted with a dread of *vital force*, an article in the *Monist* for July, 1899, entitled 'Biology and Metaphysics,' by that acute thinker and lucid writer, Professor C. Lloyd Morgan, as being altogether just. Professor Morgan is admitted to be an exact and painstaking biologist; but he is also what is far better and rarer, a profound and philosophic thinker.

Perhaps I have already said too much. All I can ask is that those interested, unbiased by the fault-finding criticism, will examine for themselves in a fair and sympathetic spirit. I do not fear the result.

JOSEPH LE CONTE.

BERKELEY, CAL., May 24, 1900.

## GLACIAL EROSION IN THE WHITE MOUNTAIN NOTCHES.

TO THE EDITOR OF SCIENCE: In *Appalachia* for March, Professor W. M. Davis discusses the glacial erosion of certain over-deepened valleys in the Alps and the relation that is borne to them by the hanging valleys of their tributaries. He suggests that "the head of the Saco valley in the White mountains below Crawford notch deserves examination to see how far its smooth sides and U-shaped cross-section may be explained as the results of glacial scouring by an ice stream that hurried through the deep opening in the White mountain mass." The present note may throw some light on this question.

It is in the first place remarkable that, although there are valleys of east and west trend in northern New Hampshire, all the deeper notches and passes practicable for roads through the main mountain group extend from north to south, as would be natural if the notches had been deepened by ice streams moving in the general direction of the glacial striæ in New England. Moreover, Carter notch as seen from a distance, the Crawford notch as seen from Mt. Willard, and Franconia notch, all present essentially U-shaped cross sections, their troughs being bordered by continuous cliffs rather than by projecting spurs, thus suggesting erosion in a roughly horizontal direction along the sides of a glacial channel, rather than down-hill erosion by streams on the side slopes. In the second place, if one climbs Carter dome from the notch, the path is so steep for the first eighth of a mile that one must cling to the trees to ascend it; but then there suddenly comes a gentler slope. As a boy I climbed the western wall of the White mountain or Crawford notch by way of the bed of Brook Kedron, south of the Willey House, and found it so steep as to be almost impracticable; but here again a point was reached from which the stream was seen coming leisurely over the plateau south of Mt. Willey before its plunge down to the Saco on the floor of the main valley. Standing on Mt. Willard, one looks east across the notch trough to where the Silver and Crystal cascades slip and leap down over the shining ledges, now and then disappearing in narrow clefts that

they have worn in the rock; but above the cascades, one sees the wooded valleys of the streams as mountain hollows enclosed by gradual slopes that lead up to the heights north of Mt. Webster. These features seem to correspond to the hanging valleys of the Alps, although their dimensions are comparatively insignificant. East of Mt. Washington, the point of the spur between Tuckerman's and Huntington's ravines has the appearance of having been sheared off; and over the verge of the steep slope thus formed swings the white thread of Raymond's cataract, recalling the gauzy veils of the Yosemite cliffs.

Another characteristic of the glaciated and over-deepened Alpine valleys with their cliff walls is repeated in the rock falls from the sides of the White mountain valleys. The floor of Carter notch is heaped with rough rock fragments, forming two little ponds. The avalanche that killed the dwellers in the old Willey house is famous; the sides of the upper Saco trough towards Crawford notch are scarred with the paths of many other slides; and the Saco flows beneath heaped granite blocks that have fallen from the enclosing cliffs. Long talus slopes descend from the foot of the shear cliffs of the Franconia notch. These phenomena are not normally characteristic of mountains so old as those of New Hampshire, although they seem appropriate enough to ice-cut notches in old mountains.

The notch streams are not large enough to have produced prominent waste fans; yet north of the gate of Crawford notch—evidently the old divide—the streams which come down from the east and west, in Gibb's falls and Beecher's cascades respectively, have built a double fan where the Crawford house now stands, thus forming a new divide, on which one stream turns south to form the Saco. Probably the waste here was largely accumulated as a delta when the district to the north was a glacial lake that had its outlet southward over the old divide into the notch. The attitude of the headwaters of the north-flowing Peabody river would indicate that they had been diverted similarly from a southern course into the south-flowing Glen Ellis river by a waste filling on the floor of Pinkham notch near the old divide.

The general form and the recent changes in the White mountain notches thus indicate that they are the result of strong glacial erosion along the course of north and south valleys.

Philip Emerson.

Lynn, Mass.

## FLOATING SAND AND STONES.

Perusal of Dr. Erland Nordenskiold's description (*Nature*, vol. 61, p. 278, January 18, 1900) of the floating stones which he observed during his journey along the southwestern coast of Patagonia and of Professor Simonds's discussion of the topic in Science (Vol. XI, N. S., pp. 510–512, March 30, 1900), prompts me to add a locality to those already mentioned at which sand and stones have been observed floating on water. While camping on the 'Thumb,' or West Arm, of Yellowstone Lake, Wyoming, in July, 1899, the writer and other members of the party, among whom were several geologists, saw dark patches from two to six inches in diameter on the surface of the lake. These patches were numerous near the shore, and occasional ones were noted as far out as we could see. Examination showed that they were composed of the coarse black and red obsidian sand which forms much of the lake shore. The sand consisted for the most part of subangular particles 2 or 3 mm. in diameter, but pebbles 5 or 6 mm. across were frequently seen, and at least one fully 10 mm. long and rudely ellipsoidal in shape was observed by the writer among these floating aggregations. The material was solid glass, not cellular, and probably had a specific gravity of 2.345 (see J. P. Iddings, in 7th Ann. Rep. U. S. G. S., p. 291). The sand was not very dry, on the other hand, it seemed to be rather damp, when it was picked up from the shore by the gentle ripples and carried out by the moderate current produced at this locality by the inflow from an adjacent hot spring area. Ripples which did not break the surface of the water did not destroy the patches of floating sand, but crested wavelets precipitated the particles at once and stopped the formation of other patches along the shore line. The conditions therefore at this locality are a sand composed of material somewhat repellent to water and motion of the

water strong enough to lift the particles of rock without agitating them enough to overcome the surface tension of the water. Here, again, as has been noted by other observers, the fine particles appear to gather about the larger ones and help to support them.

E. O. HOVEY.

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### DIURNAL RANGE OF TEMPERATURES.

TO THE EDITOR OF SCIENCE: In the last issue of SCIENCE, page 872, attention is called by Professor R. DeC. Ward to a remarkable diurnal range of temperature. Nothing is said about the elevation or other conditions of the point of observation, but the article calls to mind my own experiences near the summit of Mauna Kea, on the Island of Hawaii. We were in camp on the shore of Lake Waiau nearly a week in July, 1892. The elevation was slightly over 13,000 feet—2000 feet above the last limit of vegetation, and about 1000 feet below the summit. The thermometer, always occupying the same position, read 13° F. at night and 108° in the daytime.

E. D. PRESTON.

### EOGÆA AND ANTARCTICA.

TO THE EDITOR OF SCIENCE: At last I send an abstract of my remarks 'On the zoo-geographical relations of Africa,' given at the last session of the National Academy of Sciences. I have been obliged to omit some points for want of time. As I find that some of my views long ago promulgated have been overlooked, or are being taken up now as new and attributed to others, I take this opportunity to refer to several articles, including especially such as have been published in SCIENCE:

1. 'On the Geographical Distribution of Fishes.' (*Ann. Mag. Nat. Hist.* (4), XV., 251–255, April, 1875.)

2. 'Fish.' (Johnson's New Univ. Cyclopædia, II., 116–119, 1876.)

3. Wallace's 'Geographical Distribution of Animals.' [A Review.] (*The Nation*, XXIV., 27, 28; 42, 43, July 12 and 19, 1877; reprinted (*Field and Forest*, III.), 69–74: 78–80; 98–101, 1877.)

4. 'Zoological Geography.' (Johnson's New Univ. Cyclopædia, IV., 1754–1760, 1878.)

5. 'The Principles of Zoogeography.' A presidential address, etc. (*Proc. Bio. Soc. Wash.*, II., 1–39, 1883.)

6. 'A Comparison of Antipodal Faunas.' (*Nat. Acad. Sc. Memoirs*, VI., 89–124, 1894.)

7. 'A Text-book of Zoo-geography.' By Frank E. Beddard. [A Review.] (SCIENCE, N. S., II., 272–274, August 30, 1895; Corrections, 342, Sept. 13, 1895.)

8. 'The Early Segregation of Fresh-Water Types.' (SCIENCE, N. S., II., 678, 679, Nov. 22, 1895.)

9. 'The Origin and Relations of the Floras and Faunas of the Antarctic and Adjacent Regions.' (SCIENCE, N. S., III., 305–320, February 28, 1896.)—'Vertebrata of the Land: Fishes, Batrachia and Reptiles.' (*Op. cit.*, 314–317.) 'Vertebrata of the Sea.' (*Op. cit.*, 319–320).

10. 'Principles of Marine Zoo-geography.' (SCIENCE, N. S., III., 514–516, April 3, 1396.)

11. 'The Distribution of Marine Mammals.' (SCIENCE, N. S., V., 955, 956, June 18, 1897.)

THEO. GILL.

WASHINGTON, May 28, 1900.

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## *NOTES ON PHYSICS.*

### THE ABSORPTION OF LIGHT IN A RAREFIED GAS AND THE SUN'S CORONA.

MATHIAS CANTOR in the *Annalen der Physik* for March, 1900, describes an experiment showing that a rarefied gas through which an electric discharge is passing has no perceptible absorption spectrum corresponding to its emission spectrum, and Professor G. F. Fitz Gerald in *Nature* May 3, 1900, remarks that this fact confirms the suggestion that the sun's corona is an aurora around the sun (an electrical discharge phenomenon) inasmuch as the bright spectrum line of the corona is not represented by a dark line in the solar spectrum.

The absence of an absorption spectrum corresponding to the emission spectrum of a rarefied gas through which an electric discharge is passing is very likely due to very great concentration of kinetic energy, among a few types of the molecular motion of the gas so that in regard to its emission the gas is potentially at an excessively high temperature.

### MODERN VIEWS OF MATTER.

Professor Oliver Lodge in the *International Monthly* for May reviews the modern views of matter touching more particularly upon J. J. Thomson's electro-corpuscular theory, and upon Johnstone Stoney's electron theory. It has been known since Maxwell's time that a moving electric charge stores kinetic energy so that work is required to set it in motion and it does work when it is stopped, that is, an electrical charge is endowed with that most perplexing property of matter inertia. Johnstone Stoney's theory is that atoms of matter are aggregrates of electrons, an electron being, as it were, a stretched spot in the ether or a very small electric charge. J. J. Thomson's corpuscular theory is more or less similar to the electron theory only that J. J. Thomson has pretty clearly shown by experiment that what he calls a corpuscle exists, that its mass (inertia) is about 1/500 of the mass of the hydrogen atom and that it carries a definite negative electric charge.

In a very interesting communication to *Nature*, May 10, J. J. Thomson shows that many physical phenomena can be interpreted in terms of his corpuscular theory; for example the proportionality of thermal and electric conductivity, and the variation of electrical conductivity with temperature.

W. S. F.

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### *NOTE ON A NEW ABYSSAL LIMPET.*

Under the name of *Bathysciadium conicum* Dautzenberg and H. Fischer have described* a new deep water limpet which combines some curious characters. The specimens are simply conical with radiating riblets and an almost membranaceous shell, and have a diameter of 1.5 mm. and a height of 0.9 mm. Some anatomical details are given by Dr. Pelseneer in a note appended to the description. The animal was obtained from the beak of a cuttlefish dredged by the Prince of Monaco off the Azores in 843 fathoms.

Like *Lepeta* it is without eyes or ctenidia, the respiration being carried on by the surface of the mantle. The muzzle appears to be without lappets, the right tentacle has an appendix like that of *Cocculina* (supposed to be a degenerate verge), there are no posterior filaments; an unpaired mandible and long radula are present, the nervous system is that of the Docoglossa and the otoliths are single.

Dr. Pelseneer regards the genital gland (otherwise strictly docoglossate) as hermaphrodite, a condition so exceptional, and, considering the minute size of the animal, so difficult to determine, that judgment may fairly be suspended pending further confirmation of it. The radula as figured leads to the belief that except in the absence of the rhachidian tooth (often degenerate in abyssal limpets) the teeth are like those of *Lepetella;* the major lateral being broken into three pieces which have been taken for three separate teeth by the author cited. If this suspicion be correct the formula is $1 + 2{\cdot}0{\cdot}2 + 1$, for a transverse series of the radula. The creature will be the first true limpet (Docoglossa) to show any trace of a verge, and if really hermaphrodite, the first to exhibit this character. The single otolith is very likely correlated with the small size of the animal. The genus will stand next to *Lepetella* among the Abranchiate Docoglossa.

Wm. H. Dall.

* Bull. Soc. Zool. de France, xxiv., p. 207.

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### *THE PLANET EROS.*

A letter from the Arequipa Station of the Harvard College Observatory of June 1, 1900, gives details concerning four photographs of Eros taken there in April with the Bruce telescope, by Dr. Delisle Stewart. An adjacent star was followed in an eye piece and by means of a micrometer screw the photographic plate was moved with regard to it by an amount and in a direction equal to the motion of Eros. The stars thus appeared as trails and Eros as a point. Approximate positions were determined from the plates at Arequipa with the results given below. Paper prints of two of these plates were sent to Cambridge and measures of them are also given. The negatives are now on their way to Cambridge, and as soon as received accurate positions will be derived from them.

These appear to be the first observations of Eros since its conjunction with the Sun. The

second observations taken a month later are given in the accompanying bulletin. Efforts have been made at Cambridge to observe Eros, both visually and photographically, but have failed, owing to twilight.

| Plate. | Date 1900. | G. M. T. | R. A. 1900. | Dec. 1900. |
|---|---|---|---|---|
| A 4333 | April 26 | $21^h\ 20^m$ | $22^h\ 49^m\ 21^s$ | $-5°\ 46'.0$ |
| " | " | " | 49 23 | −5 46 .4 |
| A 4334 | " | 22 06 | 49 27 | −5 45 .8 |
| A 4338 | April 27 | 21 47 | 51 23 | −5 29 .6 |
| A 4341 | April 30 | 21 16 | 57 7 | −4 42 .1 |
| " | " | " | 57 1 | −4 42 . |

A LETTER has been received at the Harvard College Observatory from Professor H. A. Howe, at Denver, stating that Eros was observed with the 20-inch refractor of the Chamberlin Observatory with the following results:

| Gr. M. T. | Apparent R. A. | Apparent Decl. | Comp. Stars. |
|---|---|---|---|
| May 27, 90729 | $23^h\ 47^m\ 3^s.43$ | $+2°\ 46'\ 27''.3$ | Boss 8197 |
| May 27, 91859 | 23 47 4 .37 | +2 46 38 .6 | Boss 8198 |

After taking parallax and aberration into account, a comparison of these observations with the ephemeris of J. B. Westhaver in A. J. No. 479 gave the following corrections to that ephemeris:

| Gr. M. T. | | |
|---|---|---|
| May 27, 90729 | $+1^s.7$ | $+28''$ |
| May 27, 91859 | +1 .5 | +28 |

Estimated Magn. 13.

So far as known this is the first visual observations of Eros since its conjunction with the Sun.

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### *THE CAMBRIDGE EXPLORING EXPEDITION TO THE SIAMESE-MALAY STATES.**

ALL the members of this expedition have now returned to England. After the arrangement of the necessary preliminaries at Pangkok, the party proceeded to Singora, where the active work of the expedition commenced by an exploration of the Inland Sea, which measures, roughly speaking, 60 miles by 20. The birds' nest islands were visited and the now somewhat rare method of tree-burial investigated, as well as the habits of a peculiar, isolated tribe called Phram who are believed to be of Indian origin. The tree-graves were usually cigar-shaped wrappers, or rather shells made of laths and suspended horizontally at a height of six to eight feet from the ground between two tree-trunks, branches, or posts. The corpse is exposed in one of these shells (the heels being generally left higher than the head) and allowed to decay till the bones are clean, after which the bones should be collected and burnt. Box-like receptacles on posts, as among the Madangs of Borneo, are occasionally substituted for the wrappers. On this journey some strange articles of diet were served up to the two members of the expedition, among them being red ants, toads, bee grubs, and a species of cicada. The manner in which the latter are caught is peculiar. Two or three natives gather at night round a brightly-burning wood-fire, one of them holding a lighted torch. The others clap their hands at regular intervals and the cicadæ, attracted by the noise and guided by the light, fly down and settle upon the people as they stand by the fire. On this same journey a couple of young leopard or panther cubs were picked out of their nest in a hollow tree by the roadside. But it was found difficult to feed them, and they were therefore suckled by a Siamese woman who claimed to have previously suckled a bear.

From Singora the party proceeded to Patani, and ascended Gunong Besar or Indragiri to a height of 3000 feet. The next place visited was Biserat, in Jalor (Jala), which proved an excellent collecting ground until smallpox broke out. The limestone caves here were thoroughly explored, including the fine Gua Gambar or Statue Cave, containing a colossal figure of Buddah about 100 feet in length. The party then proceeded by the overland route through Raman, Ligeh, Ulu, Kelantan, and up the Lebih, a distance of about 200 miles, performed by elephants, rafts, and boats, as far as Kuala Aring. Hence Mr. Skeat, with six Malays, set out on a scouting expedition to explore the route to the Tahan Mountain, the highest peak in the Malay Peninsula, which reaches an altitude of about 10,000 feet. Mr. Skeat's party was absent about five weeks from camp, and got sight of an unrecorded peak named Gunong Larong, or 'Coffin Mountain,' not much inferior to the Tahan Mountain.

The expedition then descended to the coast, and after spending about two months in the

* From the London *Times*.

chief towns of Kelantan and Trengganu, proceeded by steamer to Penang, whence Mr. Evans paid a visit to Pulau and Bidan, Messrs. Yapp and Laidlaw ascending Gunong Inas. Mr. Skeat proceeded to Kedah to study the aboriginal Jungle-tribes of the interior.

It is understood that the expedition has been eminently successful, and has brought back very extensive zoological, botanical, and ethnological collections. The results obtained should be of value for purposes of comparison with the results of the recent successful Cambridge Anthropological Expedition of Dr. Haddon to the Torres Straits, Sarawak, and New Guinea.

The party was under the leadership of Mr. Skeat, of Christ's College, Cambridge, and comprised Messrs. Evans and Annandale, of Oxford, and Messrs. Yapp, Laidlaw, and Gwynne-Vaughan, of Cambridge.

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*SCIENTIFIC NOTES AND NEWS.*

MR. O. H. TITTMANN will succeed to the superintendency of the United States Coast and Geodetic Survey, filling the vacancy caused by Dr. H. S. Pritchett's election to the presidency of Massachusetts Institute of Technology.

LORD RAYLEIGH has been appointed by the British Government chairman of a committee which is to investigate gunpowders and designs of guns with which they may be used to the best advantage.

DR. ED. SUESS, professor of geology in the University of Vienna, has been elected a foreign associate of the Paris Academy of Sciences in the place vacant by the death of Sir Edward Frankland, and Sir John Burdon-Sanderson a correspondent in the place of the late Sir James Paget.

DR. S. L. TORNQUIST, of Lund, has been elected a foreign member, and Professor F. Sacco, of Turin, a foreign correspondent, of the Geological Society of London.

THE Paris Academy of Medicine has elected Professor Röntgen, of Munich, a foreign associate.

PROFESSOR W. C. BRÖGGER, of the University of Christiania, at the invitation of the University of Chicago, delivered in Chicago his lectures on the 'Principles of a Genetic Classification of Igneous Rocks,' recently delivered at the Johns Hopkins University. The lectures were attended by geologists from Illinois, Michigan, Wisconsin and Minnesota.

MR. CECIL B. CRAMPTON, assistant in the museum at Owen's College, Manchester, has been appointed an assistant geologist on the Geological Survey of Scotland.

COLUMBIA UNIVERSITY will confer its LL.D. on President Arthur T. Hadley, of Yale University, on Lord Pauncefote, the ambassador of Great Britain, and on Mr. Thomas B. Reed, late speaker of the House of Representatives.

PROFESSOR JACOB E. REIGHARD, professor of zoology in the University of Michigan, will deliver the address at the dedication of the new museum building of Alma College, Alma, Mich., on June 27th.

DR. WALTER J. SWINGLE, agricultural explorer for the United States Department of Agriculture is in Algeria. He is about to forward date palms to Arizona, in order that they may be tested there.

THE prizes offered by the National Geographical Society for the best essays on Norse discoveries in America have been awarded to Mr. Charles B. Dalton, of New York City, and Mr. K. F. Murray, of Norfolk, Va.

GENERAL W. A. GREELY, Chief Signal Service Officer, has given directions for the establishment of stations for wireless telegraphy in the harbor of San Francisco, in Porto Rico and the Philippines.

THE death is announced at the age of 87 years of M. Ravaisson Mollien, formerly professor of philosophy at Rennes, inspector general in the Department of Higher Education and curator in the Department of Antiquities at the Louvre. He was the author of many works on philosophy and æsthetics. The death is also announced of M. Hippolyte Stupuy, at the age of seventy years. He was curator of the artistic collections of the City of Paris and the author of works on philosophy and of a biography of the mathematician, Sophie Germain.

A DONOR, who wishes not to have his name mentioned, has presented to the American Mu-

seum of Natural History the collection exhibited by Messrs. Tiffany & Co. at the Paris Exposition, consisting of American and foreign cut and uncut precious stones and other objects. The value of the gift is over $50,000.

WE learn from *Nature* that by the will of the late Mr. G. J. Symons, F.R.S., a valuable bequest is made to the Royal Meteorological Society. He bequeathed to the Society all his books, pamphlets, maps and photographs, a copy of which is not already in its library. He also bequeathed the testimonial album presented to him by the Fellows of the Society in 1879 and the sum of 200*l*.

THE Brooklyn Institute of Arts and Sciences has received from an anonymous friend $5000, to be added to the endowment fund of the Institute.

WALTER S. DICKSON, of Salem, Mass., has bequeathed $10,000 and a fifth of his residuary estate to the public library of that city and $10,000 conditionally to the Essex Institute. John Curtis has bequeathed $15,000 for a public library building at Hanover, Mass. The Hon. E. J. Lawrence has offered to give $8000 for a library building at Fairfield, Me.

THE British Iron and Steel Institute held its annual meeting at London on May 9th and 10th. Mr. Carnegie announced his intention of founding a scholarship in connection with the Institute for the advancement of research in connection with iron and steel.

THE anniversary meeting of the Royal Geographical Society was held on May 21st. In accordance with the arrangements we have already in part announced, the Founder's medal was awarded to Captain H. H. P. Deasy, for the exploring and survey work which he has accomplished in Central Asia during two expeditions lasting three years altogether. The Patron's medal was awarded to Mr. James McCarthy, for his great services to geographical science in exploring all parts of the kingdom of Siam, for his laborious work during 12 years in collecting materials for a map to form the basis of a survey system, and for his admirable map of Siam just completed. The Murchison award for 1900 was made to M. H. Arçtowski, for his work on the Belgian Antarctic expedition. The Gill memorial for 1900 was awarded to Mr. Vaughan Cornish, for his researches on sea-beaches, sand-dunes, and on wave-forms in water. The Back grant for 1900 was awarded to Mr. Robert Codrington, for his journeys in the region between Lakes Nyasa and Tanganyika, during which he removed a section containing the inscription from the tree under which Livingstone's heart was buried. The Cuthbert Peek grant for 1900 was awarded to Mr. T. J. Alldridge, for his journeys in the interior of Sierra Leone. The president, Sir Clements Markham, said in the course of his address that £30,000 was still required for the Antarctic Expedition, but that the keel of their exploring ship had been lain at Dundee.

THE New York State Museum will conduct during the summer a station on Lake Saranac for the study of aquatic insects. It will be under the direction of Dr. Charles Needham.

THE University of the State of Missouri is to send an entomological expedition into southern Mexico this summer. It will be in charge of Professor J. M. Stedman, head of the Entomological Department, and will have for its object the making of a biological, largely entomological, survey of the region from Vera Cruz on the Gulf, which is in perpetual tropics, to the top of the volcano Popocatepetl, which is far above the perpetual snow line, and down to Acapulco on the Pacific. This will give all the temperature variations from perpetual tropics to perpetual snow, and will allow of the study of life zones under conditions not to be found elsewhere in North America. The collection will become the property of the University, which is to furnish half the expenses, the other half to be borne by Professor Stedman.

M. A. CARLETON, of the Division of Vegetable Physiology and Pathology, U. S. Department of Agriculture, is now in Paris installing the exhibit illustrating cereal production in the United States. Early in June Mr. Carleton will visit Russia for the purpose of collecting new varieties of cereals for introduction into the United States.

MR. ALBERT F. WOODS, of the Division of Vegetable Physiology and Pathology, U. S. Department of Agriculture, has prepared an ex-

tensive paper on a disease of carnations which hitherto has been known under the name 'bacteriosis.' Mr. Woods's studies, which have been carried on for several years, seem to prove conclusively that the disease is due to the punctures of insects, principally aphides, and thrips. For this reason he suggests the name 'stigmonose' for the malady. The paper is illustrated by plates and text figures and will be ready for distribution early in June.

THE work on tobacco inaugurated last year by the Division of Vegetable Physiology and Pathology, U. S. Department of Agriculture, is being continued. The work is in charge of Dr. Oscar Loew, and has for its principal object the study of fermentation of the tobacco leaf. Some important results bearing on the changes which take place in the fermentation of the leaf have already been obtained. A paper giving the results of the work in detail will soon be published by the Department.

THE second annual meeting of the Astronomical and Astrophysical Society of America (Fourth Conference of Astronomers and Astrophysicists) will be held in conjunction with the meeting of the American Association at Columbia University beginning on June 26th. In addition to papers which may be presented to the Society, arrangements are being made for a series of open discussions upon the following topics: The Eclipse of May 28, 1900; Observations of Eros to be made at the next Opposition; Spectroscopic Determinations of Motion in the Line of Sight.

ANNOUNCEMENT is also made of the meeting of the American Forestry Association at the same time and place. It is expected that the Hon. James Wilson, Secretary of Agriculture will preside at the sessions.

THE Millinery Merchants' Protective Association which, it is said, controls ninety per cent. of the millinery trade of the country, has proposed to the various Audubon Societies to cease killing or buying any North American birds, except such as are edible and killed in their season, if the societies will undertake not to interfere with the use of these birds or with skins imported from countries not in North America.

THE British Ornithologists' Union has passed the following resolution: "That any member of the union directly or indirectly responsible for the destruction of nests, eggs, young or parent birds of any species mentioned below should be visited with the severest censure of the Union and Club." The birds referred to are the chough, golden oriole, hoopoe, osprey, kite, white-tailed eagle, honey buzzard, common buzzard, bittern, and ruff.

A DISPATCH from Bombay, reports that an unprecedentedly severe epidemic of cholera has broken out in the northern districts of Bombay Presidency, especially in the famine camps, and that the deaths had increased 40 per cent. within three days. In the Kaira District there have been 330 deaths in seven days. The government has made a special grant of £1000 to cremate the dead immediately. In Plaupur State on the first day there was one death, on the second there were eighty-four, and on the third there were upwards of four hundred.

THE *Scientific American* states that progress is being made in regard to the introduction of the metric system in Russia. The bill which has been prepared by the Minister of Finance has received the approbation of the State Council, with the understanding that the University and the various scientific societies will give their assistance in the verification of the weights and measures necessary for commercial use. The details have been nearly all decided upon, and will be submitted to the Council in the near future. Since 1896 the metric system has been used by the medical service of the army in the compounding of formulas, this having been made obligatory.

THE next meeting of the International Committee of Weights and Measures will be held at Paris on September 10th of the present year.

THE committee of the Liverpool School of Tropical Diseases have decided to dispatch at an early date an expedition to the Amazon to investigate yellow fever. This is the third expedition organized by the school within the last nine months. It will probably in the first instance proceed to Baltimore to confer with the yellow fever experts at the Johns Hopkin

University, afterwards going to Para and other places on the South American coast.

THE London correspondent of the N. Y. *Evening Post* reports interesting discoveries of the Hellenic Society in the Palace of Minos at Knossos, near Candia in Crete. On the west of the palace was found a long series of stone galleries with immense decorated oil jars in position and stone receptacles for oil under the floors. A great plaster bull in relief, of artistic excellence for that period, has come to light, and the lower part of a fresco showing a long procession of white-footed ladies in richly embroidered garments and red-footed men semi-nude. In other realistic frescoes of ladies the colors are well preserved. A magnificent set of vases in marble, steatite, and other stones also has been collected, the finest being in the form of a mastiff's head of Parian marble. Clay vases unearthed include a set of perfect vases of the peculiar fantastic and highly colored style which preceded the Mycenæan in Crete. This remarkable ware was only known previously from a few fragments. There are also many remains of a stone age settlement, black geometric pottery, and stone weapons. This completes the series of objects representing the history of Crete from the stone age to about the seventh century B. C. They are said to revolutionize ideas about pre-Hellenic civilization in the Ægean, but the most important fact is the constant evidence of influence from intercourse with the Egypt of the eighteenth and subsequent Pharaonic dynasties.

MR. CHARLES ADAMS, the editor of the *Verulam Review*, an anti-vivisection journal, brought suit against the British Medical Association for damages owing to a statement in regard to him in the *Journal* of the Association. Although Mr. Adams's counsel alleged on his behalf that he was 'an old gentleman and was irritable' the jury did not hesitate to bring in a verdict in favor of the defendants requiring Mr. Adams to pay the costs.

THE director of the U. S. Geological Survey, Dr. Charles D. Walcott, has sent a notice in answer to numerous questions concerning the issue of 'Mineral Resources of the United States, 1898,' to the effect that the following provision was included in an act of Congress approved March 2, 1895: "*Provided*, That hereafter the report of the mineral resources of the United States shall be issued as a part of the report of the Director of the Geological Survey." In conformity with this act of Congress, 'Mineral Resources, 1898,' containing a statement of the production of every mineral in the United States, with its value, where it is found, and where it can be sold, etc., will be published as Part VI. of the 'Twentieth Annual Report of the United States Geological Survey.' The series will continue in succeeding annual reports. Application for the report should be made to members of Congress, who will have a limited number for distribution. The small edition furnished to the office is sufficient only to meet the demands of exchanges and contributors.

FROM the *British Medical Jonrnal* we learn that before the Académie de Médecine in Paris, M. Laveran after presenting an important report on the study of malaria concluded by proposing, first, that the Académie should appoint a committee on malaria; secondly, that it should pass a resolution calling on the Government to send an expedition to Algeria to study in some of the unhealthiest parts of that colony, the relations of mosquitoes to malaria, and the most effectual means of prophylaxis. The proposals were supported by Professor R. Blanchard, who, we understand, has already pressed on the French Government the necessity of founding a French School of Tropical Medicine. He mentioned that he had recently made a catalogue of all the species of *Anopheles* now known, which showed that the geographical distribution of these insects corresponds exactly with that of malaria. M. Laveran's proposals were adopted by the Académie. A committee for the study of malaria was appointed, consisting of MM. Kelsch, Laveran, Blanchard, Railliet and Vallin.

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## *UNIVERSITY AND EDUCATIONAL NEWS.*

MESSRS. SAMUEL CUPPLES and Robert S. Brookings have each given to Washington University one-half of the total capital stock of the St. Louis Terminal Cupples Station and Property Company, which company owns the so-

called 'Cupples Station.' The annual income from this gift to the University will be from $120,000 to $130,000 per year. The gift is to form a permanent endowment fund, the interest of which is to be expended by the Board of Directors in any way which it sees fit.

By the will of the late Jonas G. Clark of Worcester, Mass., who founded Clark University in 1889, the entire estate is left to the university, providing the people of Worcester raise a fund of $500,000. If the sum of $250,000 is raised, he bequeaths $500,000. If $500,000 is raised, he bequeaths $1,000,000 and makes the university his residuary legatee. He also leaves $100,000 for the university library and $100,000 for a department of art.

Dr. D. K. Pearsons has offered $50,000 to Carleton College, Northfield, Minn., on condition that the college authorities raise $100,000 before Jan. 1, 1901.

The late Edward Wheelwright has left his estate, after the death of his widow, to be divided equally between Harvard University and the Boston Museum of Fine Arts.

The collection of water colors belonging to the late Professor O. C. Marsh, being part of the estate left by him to Yale University, have been sold for about $500. They are said to have cost over $10,000.

By the will of Henry M. Curry the Western University of Pennsylvania receives $10,000 for scholarships.

The University of Pennsylvania has received $20,000 each, from Mr. J. D. Lippencott and Mr. J. G. Carruth.

The University of Michigan has followed the example recently set by Harvard, Cornell and Columbia Universities by making its entrance requirements more flexible and the same for the several degrees it still offers in its literary department. According to the new schedule, fifteen units are required for admission, a unit being one subject pursued for not less than four periods a week through a school year. The fifteen units must include three units of English, three of mathematics, and one of physics. The remaining eight units are to be selected from the following list, but they must include two units of either Latin, French or German. The figures indicate the number of units for which each subject may be counted: Greek, 2; Latin, 2 or 4; German, 2 or 4; English literature, 1; history, 1, 2 or 3; chemistry, 1; botany, 1; zoology, 1; biology (a half year each of botany and zoology), 1; physiography, 1.

Dr. Frank Morley, for the past thirteen years professor of mathematics in Haverford College, has accepted a call from Johns Hopkins University. Dr. Thomas Craig has resigned the professorship of mathematics in this University.

Professor M. C. White, who has for thirty-three years held the chair of pathology in the Medical School of Yale University, has become professor emeritus and is succeeded by Professor Charles J. Bartlett.

James M. Toumey, professor of biology in the University of Arizona and director of the Agricultural Experiment Station at Tucson, has been elected assistant professor of forestry at Yale University.

Dr. Charles A. Elwood, instructor in the University of Nebraska, has been elected professor of sociology in the University of Missouri. He is a graduate of Cornell University and the University of Chicago.

The instructors in the summer school of Harvard University include the following: In psychology, Dr. MacDougall; in education, Professor Hanus and Mr. Norton; in theory of design, Mr. Ross, Mr. Clark, and Mr. Swan; in mathematics, Dr. Smith, Mr. Love, Mr. Ashton, and Dr. Campbell; in astronomy, Mr. Reed; in engineering, Mr. Turner; in shopwork, Professor Burke; in physics, Professor Sabine, Mr. McElfresh, and Mr. Collins; in chemistry, Dr. Torrey, Mr. Wheeler, and Mr. Black; in botany, Mr. Olive and Mr. King; in geology, Professor Shaler, Professor Brigham, Mr. Woodworth, and Mr. Woodman; in geography, Professor Davis and Mr. Burr; in mineralogy, Dr. Eakle; in physical training, Dr. Sargent.

Miss Cora J. Beckwith, assistant in the zoological laboratory of the University of Michigan, has been appointed assistant instructor in zoology at Vassar College for the year 1900 1901.

# SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; JOSEPH LE CONTE, Geology; W. M. DAVIS, Physiography; HENRY F. OSBORN, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; C. E. BESSEY, N. L. BRITTON, Botany; C. S. MINOT, Embryology, Histology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; WILLIAM H. WELCH, Pathology; J. MCKEEN CATTELL, Psychology; J. W. POWELL, Anthropology.

FRIDAY, JUNE 15, 1900.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

## *THE APPROPRIATIONS FOR THE DEPARTMENT OF AGRICULTURE FOR 1901.*

THE Congressional Act making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1901, shows an increase of more than $280,000 over the appropriations for the preceding year. The total amount is $4,023,500 of which $720,000 is for the experiment stations in the 48 States and Territories, $12,000 for the stations in Alaska, $10,000 for a new station in Hawaii, 'including the erection of buildings, the printing (in the Hawaiian Islands), illustration and distribution of reports and bulletins, and all other expenses essential to the maintenance of said station,' and $5000 for an investigation and report to Congress on the Agricultural resources and capabilities of Porto Rico, "with special reference to the selection of locations for agricultural experiment stations and the determination of the character and extent of agricultural experiments immediately demanded by the conditions of agriculture in that Island; to prepare, print publish and distribute in Porto Rico, circulars of inquiry and bulletins of information in the English and Spanish languages."

The sum of $10,000 was appropriated for the purpose of commencing the necessary improvements for the establishment and maintenance of a general experimental farm and agricultural station on the Arlington Estate, on the Virginia shore of the Potomac.

The appropriation for the Office of Experiment Stations is $33,000, and the special investigations in charge of this Office are provided for as follows: Nutrition of man $17,500, an increase of $2500; and Irrigation $50,000, an increase of $15,000.

The largest increases in the appropriations are for the Bureau of Animal Industry, Divisions of Forestry and Seeds, and the Weather Bureau. The appropriation for the Bureau of Animal Industry is $1,078,830, an increase of $46,800. The appropriation for Animal Quarantine Stations is increased from $12,000 to $50,000. The Division of Forestry receives an increase of $40,000, $5000 of which may be used to investigate the forest conditions of the southern Appalachian Mountain regions of western North Carolina and adjacent States. The appropriation for the Division of Seeds is increased from $130,000 to $170,000. The increased appropriation for the purchase of seed was due in a large measure to a petition of some 225 members of the House of Representatives. The total appropriation for the Weather Bureau is $1,058,320, an increase of $35,838. The work of the Bureau is to be extended to the Hawaiian Islands. The salary of the Chief of the Bureau is increased to $5000.

In addition to the lines of work previously undertaken the Division of Chemistry is charged with new duties, as follows:

"To investigate the cause of the deterioration in the gluten content of wheat on the Pacific Coast and in other parts of the country. To study the methods for increasing the content of valuable food constituents in wheat and other cereals. * * *

"To investigate the character of proposed food preservatives and coloring matters. To determine their relations to digestion and to health and to establish the principles which should guide their use.

"To investigate the character of the chemical and physical tests which are applied to American food products in foreign countries, and to inspect, before shipment, when desired by the shippers or owners of these food products, American food products intended for countries where chemical and physical tests are required before said food products are allowed to be sold in the countries mentioned." The appropriation for this Division is $35,600.

The appropriation for the Division of Agrostology was increased $5000 making its total appropriation $25,100. The work of the Division is enlarged to include investigations as to the best methods for exterminating Johnson and other noxious and destructive grasses and co-operative experiments to be carried on in connection with the agricultural experiment stations "in establishing and maintaining experimental grass stations for determining the best methods of caring for and improving meadows and grazing lands, the use of different grasses and forage plants and their adaptability to various soils and climates, the best native and foreign species for reclaiming overstocked ranges and pastures, for renovating worn out lands, for binding drifting sands and washed lands, and for turfing lawns and pleasure grounds."

The Division of Entomology receives $33,200, an increase of $2500. A special investigation is ordered as to 'the ravages of the codling moth with a view to ascertaining the best method of its extermination.'

The sum of $34,500 is appropriated for the Division of Vegetable Physiology and Pathology. The policy of Secretary Wilson in employing the graduates of agricultural colleges as scientific aids has received the endorsement of Congress by an express provision for the employment of such aids in this Division.

Of the $31,300 appropriated for the Division of Soils, $10,000 may be used 'for the purpose of demonstrating the practical

value of underdrainage and other methods of reclaiming alkali lands.' The appropriation for this Division is $5000 greater than last year.

The fund used in making investigations as to the adaptability of the South for profitable tea culture was increased from $1000 to $5000.

The fund provided for the Division of Publications is $130,020, an increase of $28,360. The amount set aside for the printing of Farmers' Bulletins is $22,500 greater than last year. Four-fifths of the Farmers' Bulletins are to be sent out by members of Congress instead of two-thirds as formerly.

Other items of the appropriation act are as follows: Biological Survey $30,300, an increase of $2740; Division of Botany $43,080, an increase of $14,280; Division of Pomology $18,400; Public Road Inquiry $14,000, an increase of $6000; Division of Statistics $146,160; Library $14,000; and Museum $2260.

The item of $200,000 for a new laboratory which was taken out of the Agricultural Bill and put with those for other public buildings in the Sundry Civil Bill failed to pass.

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## *VARIATION AND SOME PHENOMENA CONNECTED WITH REPRODUCTION AND SEX.*

### II.

### EFFECT OF CHANGED CONDITIONS IN ASEXUAL REPRODUCTION.

THIS brings us to the consideration of the question reserved: Are genetic variations ever found in asexual reproduction?

If the views expressed in the earlier part of this address are correct it would seem to follow that genetic variations are variations in the actual constitution, and are inseparably connected with the act of conjugation. The act of conjugation gives us a new constitution, a new individuality, and it is the characters of this new individual in so far as they differ from the characters of the parents which constitute what we have called genetic variations. According to this the answer to our question would be that genetic variations cannot occur in asexual reproduction, and that if any indefinite variability recalling genetic variability makes its appearance* it must be part of the genetic variability and directly traceable to the zygote from which the asexual generations started.

But if genetic variability is not found in asexual reproduction the question still remains, can the other kinds of variations—namely, those due to the direct action of external forces upon the organism—be transmitted in asexual reproduction? Now we have already seen that the effect of external agencies acting upon the organism must be regarded under two heads, according as to whether the reproductive organs are or are not affected. If the reproductive organs are not affected, then variations caused by the impact of external forces will

* Weismann, *On Heredity*, vol. ii, English edition, p. 161. Warren, E. 'Observation on Heredity in Parthenogenesis,' *Proc. Roy. Soc.* 65, 1899, p. 154. These are the only observations I know of on this subject. They tend to show the presence of a slight variability, but they are not entirely satisfactory. In connection with this matter I may refer to Weismann's view that *Cypris reptans*, the species upon which his observations were made, reproduces entirely by parthenogenesis, and has lost the power of sexual reproduction. This view is based on the fact that he has bred forty consecutive parthenogenetic generations and has never seen a male. As Weismann bases some important conclusions on this view, with regard to the importance of conjugation in rejuvenescence of organisms, I may point out that the fact that he has bred forty successive generations and has never seen a male cannot be regarded as conclusive evidence that males never appear. We know of many cases in which reproduction can continue for more than forty generations without the intervention of conjugation, *e. g.*, ciliated infusoria, many plants, and of other species of crustacea in which the male is very rare and only appears after long intervals.

not be transmitted; if, on the other hand, they are affected, the next generation will show the effect. We have further seen that in the case of sexual reproduction a modification of the reproductive organs will, because of the intervention of conjugation, appear as an increase in genetic variability only. How will the matter stand in the case of asexual reproduction? First, with regard to modifications which do not affect the reproductive system—they, as in sexual reproduction, will not be transmitted. Secondly, as regards modifications which do affect the reproductive organs—they will be transmitted, *i. e.*, they will affect the next generation; and the question arises, how will they be transmitted? For here we have the opportunity wanting in the case of sexual reproduction of studying the transmission of modifications of the reproductive system without the complications introduced by the act of conjugation.

In considering this matter, it must be remembered that the reproductive organs are with regard to external influences exactly as any other organ. They can be modified either directly or indirectly, though they are in animals often less liable to direct modification by reason of their internal position.* These modifications may, as in the case of other organs, be obvious to the eye of the observer, or they may be so slight as only to be detected by an alteration of function. Now, in the case of the reproductive organs this alteration of function will show itself in the individuals of the next generation (if not before) which proceed directly and without any complication from the affected tissue. How will these individuals be affected? Will they all be affected in the same kind of way or will they be affected in different ways? Finally, will the modification last their lives only, or will it continue into subsequent asexually produced generations?

Let us endeavor to answer these questions:

(1) How will the offspring be affected? That will depend entirely upon how the reproductive organ was affected. Will the modification in the offspring have any adaptive relation whatever to the external cause? Now here we have a capital opportunity, an opportunity not afforded at all by sexual reproduction, of examining by experiment and observation the Lamarckian position. My own opinion is that there will be no relation of an adaptive kind between the external cause and the modification of the offspring. For instance, let us imagine, as an experiment, that a number of parthenogenetically reproducing organisms are submitted to a temperature lower than that at which they are accustomed to live. Let us suppose that the cold affects their reproductive organs and produces a modification of the offspring. Will the modification be in the direction of enabling the offspring to flourish in a lower temperature than the parent? My own opinion, as I have said, is that there will probably be no such tendency in the offspring, if all possibility of selection be excluded. But that is only an opinion. The question is unsettled, and must remain unsettled until it is tested upon asexually reproducing organisms.

(2) Will they all be affected in the same kind of way? Yes, presumably they will. I arrive at this conclusion, not by experiment, but by reasoning from analogy. In the case of other organs of the body, the same external cause produces in all individuals acted upon, roughly speaking, the same kind of effect, *e. g.*, action of sun upon skin, effect of transplanting maize, Porto Santo rabbits, etc. The question, however, cannot be settled in this way. It requires an experimental answer.

(3) Will the modification last beyond

* How far the abnormal position of the testes of mammalia may receive its explanation in this connection is a question worthy of consideration.

the life of the individuals produced by the affected reproductive organ? I can give no answer to this question. We have no data upon which to form a judgment. We cannot say whether it is possible permanently to modify the constitution of an organism in this way, or whether, however strong the cause may be, consistently of course with the non-destruction of life, the effects will gradually die away—it may be in one, it may be in two or more generations. There are cases known which might assist in settling these questions, but I must leave to another opportunity the task of examining them. I refer to such cases as *Artemia salina*, various cases of bud variation which cannot be included under the head of growth variation.

### SENILE DECAY AND REJUVENESCENCE OF ORGANISMS.

Another question, also of the utmost importance, confronts us at this point. As is well known, organisms are liable to wear and tear, sooner or later some part or parts essential to the maintenance of the vital functions wear out and are not renewed by the reparative processes which are supposed to be continually taking place in the organism. This constitutes what we call senile decay, and leads to the death of the organism. As a good example of the kind of cause of senile decay, we may mention the wearing out of the teeth, which in mammals at any rate are not replaced; the wearing out of the elastic tissue of the arterial wall, which is probably not replaced. There is no reason to suppose that the reparative process of any organism is sufficiently complete to prevent senile decay. There is probably always some part or parts which cannot be renewed, even in the simplest organisms. Maupas has shown that this holds for the ciliated Infusoria, and he has also shown how the renewal of life, which of course must be effected if the species is to continue, is brought about. He has shown that it is brought about by conjugation, during which process the organism may be said to be put into the melting-pot and reconstituted. For instance, many of the parts of the conjugating individuals are renewed, including the whole nuclear apparatus, which there is every reason to believe is of the greatest importance to living matter.

On reconsidering the life of the Metazoa in light of the facts established by Maupas for the Infusoria, we see that all Metazoa are in a continual state of fission, as are the ciliated Infusoria. They are continually dividing into two unequal parts, one of which we call the parent and the other the gamete. The parent Metazoon must eventually die; it cannot be put into the melting-pot; its parts cannot be completely renovated. The gamete can be put into the melting-pot of conjugation, and give rise to an entirely reconstituted organism, with all the parts and organs brand new and able to last for a certain time, which is the length of life of the individual of the species.

Is there any other way than that of conjugation by which an organism can acquire a complete renewal of its organs? Is the renewal furnished by the development of all the parts afresh which takes place in a parthenogenetic ovum such a complete renewal? This question cannot now be certainly answered, but the balance of evidence is in favor of a negative answer. And this view of the matter is borne out by a consideration of the facts of the case. In all cases of conjugation which have been thoroughly investigated, the nuclear apparatus is completely renewed. It would appear indeed as though the real explanation of the uninuclear character of the Metazoon gamete is to be sought in the necessity of getting the nuclear apparatus into the simplest possible form for renewal. Now in the de-

velopment of a parthenogenetic ovum the ordinary process of renewal of the nucleus is often in partial abeyance. As a rule it only divides once instead of twice, and there is, of course, no reinforcement by nuclear fusion. It is, of course, possible that the reinforcement by nuclear fusion which occurs in conjugation may have a different explanation from the nuclear reconstitution which takes place in the formation of polar bodies and similar structures. On the other hand, it may all be part of the same process. We cannot tell. So that we are unable to answer the question whether for complete rejuvenescence a new formation of all parts of the organism is sufficient, or whether a reconstitution of the nuclear apparatus of the kind which takes place in the maturation of the Metazoon ovum and the division of the micro-nucleus of Paramecium is also required; or finally, whether in addition to the latter phenomenon a reinforcement and reconstitution by fusing with another nucleus is also necessary for that complete rejuvenescence which enables an organism to begin the life cycle again and to pass through it completely.

With regard to buds in plants there is reason to believe that they share in the growing old of the parent. That is to say, if we suppose the average life of the individual to be 100 years, a bud removed at 50 will be 50 years of age, and only be able to live on the graft for 50 more years.

### HEREDITY.

Having now spoken at some length of the phenomenon of variation, I must proceed to consider from the same general point of view the phenomenon of heredity.

As we have seen, in asexual reproduction heredity appears, as a general rule, if not always, to be complete. The offspring do not merely present resemblances to the parent—they are identical with it. And this fact does not appear to be astonishing when we consider the real nature of the process. Asexual reproduction consists in the separation off of a portion of the parent, which, like the parent, is endowed with the power of growth. In virtue of this property it will assume, if it does not already possess it, and if the conditions are approximately similar, the exact form of the parent. It is a portion of the parent; it is endowed with the same property of growth; the wonder would be if it assumed any other form than that of the parent. Indeed, it is doubtful if the word heredity would ever have been invented if the only form of increase of organisms was the asexual one, because there being no variation to contrast with it, it would not have struck us as a quality needing a name, any more than we have a name for that property of the number two which causes it to make four when duplicated.

The need for the word heredity only becomes apparent when we consider that other form of reproduction in which the real act of reproduction is associated with the act of conjugation. Looking at reproduction from a broad point of view, we may sum up the difference between the two kinds, the sexual and the asexual, by saying that whereas the essence of sexual reproduction is the formation of a new individuality, asexual reproduction merely consists in increasing the number of one kind of individual. From this point of view sexual reproduction is better termed the creation of a new individuality, for that, and not the increase in the number of individuals, is its real result. Inasmuch as conjugation of two organisms is the essential feature of sexual reproduction, it would appear that the number of individuals would be actually diminished as a result of it; and this does really happen, though in a masked manner, for we are not in the habit of looking upon the spermatozoon and ovum as individuals, though it is absurd not to

do so, as they contain latent all the properties of the species, and are sometimes able to manifest these properties (parthenogenetic ova) without conjugating. In some of the lower organisms the fact that conjugation does not result in an increase of the number of individuals, but only in the production of a new individuality, is quite apparent, for in them two of the ordinary individuals of the species fuse to form one (many Protozoa).

So that sexual reproduction gives us a new individuality which can spread to almost any extent by asexual reproduction. This asexual reproduction gives us a group of organisms which is quite different from a group of organisms produced by sexual reproduction. Whereas the latter groups constitute what we call species, the former group has, so far as I know, no special name, unless it be variety; but variety is not a satisfactory name, for it has been used in another sense by systematizers.

Heredity, then, is really applicable only to the appearance in a zygote of some of the properties of the gametes. A zygote has this property of one of the precedent gametes, and that property of the other, in virtue of the operation of what we call heredity; it has a third property possessed by neither of the precedent gametes in virtue of the action of variation, the nature of which we have already examined. It is impossible to say which property of a gamete will be inherited, and it is impossible to predict what odd property will result from the combination of the properties of the two gametes. Of one thing only are we certain, that they are never the same in zygotes formed by gametes produced in immediate succession from the same parent.

We may thus regard the activities of the zygote as the resultant of the dashing together of the activities of the gametes.

Conjugation, then, is a process of the utmost importance in Biology; it provides the mechanism by which organisms are able to vary, independently of the conditions in which they live. It lies, therefore, at the very root of the evolution problem; the power of combining to form a zygote is one of the fundamental properties of living matter.

### SPECIES.

Now let us consider one of the effects of this property upon organisms. The effect to which I refer is the division of animals into groups called species. Species are groups of organisms, the gametes of which are able to conjugate and produce normal zygotes. Now in Nature there appear to be many causes which prevent gametes from conjugating. First and most important of all is some physical incompatibility of the living matter which prevents that harmonious blending of the two gametes which is essential for the formation of a normal zygote. Very little is known as to the real nature of this incompatibility; in fact it is hardly an exaggeration to say that nothing is known. It may be that there is actual repulsion between the gametes, or it may be in some cases, at least, that the gametes are able to fuse, but not to undergo that intimate blending which is necessary for the production of a perfect zygote. In some cases we know that something like this happens; for instance, a blend can be obtained between the horse and the ass, but it is not a perfect blend, the product or zygote being imperfect in one most important particular—namely, reproductive power.

A second cause which prevents conjugation is a purely mechanical one—viz, some obstacle which prevents the two gametes from coming together. As an instance of this I may refer to those cases amongst plants in which conjugation is impossible because the pollen tube is not long enough to reach the ovule. In yet other cases conjugation is impossible because the organ-

isms are isolated from one another either geographically or in consequence of their habits. There are probably many causes which prevent conjugation, but, whatever they may be, the effect of them is to break up organisms into specific groups, the gametes of which do normally conjugate with one another.

In many cases, no doubt, the gametes of organisms which are kept apart in Nature by mechanical barriers will conjugate fully if brought together. But in the great majority of cases it is probable that no amount of proximity will bring about complete conjugation. There is physical incompatibility. Here is a fruitful opening for investigation. Observations are urgently needed as to the real nature of this incompatibility.

### IMPORTANCE OF THE STUDY OF VARIATION.

Another and most important effect of conjugation is, as we have seen, the much-spoken-of constitutional or genetic variations. They are, as we have already insisted, of the utmost importance to the evolutionist. Evolution would have been impossible without them, for it is made up of their summation. It becomes, therefore, desirable to find out to what extent a species is capable of varying. This can only be done, as Mr. Bateson has pointed out, by recording all variations found. Mr. Bateson, in his work already referred to, has carried this out, and has shown the way to a collection of these most important data. In order to carry it further, I would suggest that the collection be made not only for structure, but also for function. This has been done largely for the nervous functions by psychologists and naturalists who pay special attention to the instincts of animals; but we want a similar collection for other functions. For instance, the variations in the phenomena of heat and menstruation, and of rut amongst mammals, and so on. To do this is really only to apply the methods of comparative anatomy and comparative physiology to the members of a species, as they have already been applied to the different species and larger groups of the animal kingdom. Such investigations cannot fail to be of the greatest interest. Indeed, when we have learnt the normal habits and structure of a species, what more interesting study can there be than the study of the possibilities of variation contained within it? Then when we know the limits of variability of any given specific group, we proceed to try if we can by selective breeding or alteration of the conditions of life alter the variability, and perhaps call into existence a kind of variation quite different in character from that previously obtained as characteristic of the species.

### THE EVOLUTION OF HEREDITY AND THE ORIGIN OF VARIATION.

These remarks bring me to the consideration of a point to which I am anxious to call your attention, and which is an important aspect of our subject. Has the variability of organisms ever been different from what it is now? Has or has not evolution had its influence upon the property of organisms as it is supposed to have had upon their other properties? There is only one possible answer to this question. Undoubtedly the variability of organisms must have altered with the progress of evolution. It would be absurd to suppose that organisms have remained constant in this respect while they have undergone alteration in all their other properties. If the variability of organisms has altered, it becomes necessary to inquire in what direction has it altered? Has the alteration been one of diminution, or has it been one of increase? Of course, it is possible that there has been no general alteration in extent with the course of evolution, and that the alteration, on the whole, has been one of quality only. But

passing over this third possibility, let us consider for the moment which of the two first named alternatives is likely to have occurred.

According to the Darwinian theory of evolution, one of the most important factors in determining the modification of organisms has been natural selection. Selection acts by preserving certain favorable variations, and allowing others less favorable to be killed off in the struggle for existence. It thus will come about that certain variations will be gradually eliminated. Meanwhile the variations of the selected organisms will themselves be submitted to selection, and certain of these will be in their turn eliminated. In this way a group of organisms becomes more and more closely adapted to its surroundings; and unless new variations make their appearance as the old unfavorable ones are eliminated, the variability of the species will diminish as the result of selection. Is it likely that new variations will appear in the manner suggested? To answer this question we must turn to the results obtained by human agency in the selective breeding of animals. The experience of breeders is that continued selection tends to produce a greater and greater purity of stock, characterized by small variability, so that if the selective breeding is carried too far, variation almost entirely ceases, and there is little opportunity left for the exercise of the breeder's art. When this condition has been arrived at, he is obliged, if he wants to produce any further modifications of his animals, to introduce new blood—*i. e.*, to bring in an individual which has either been bred to a different standard, or one in which the variability has not been so completely extinguished.

It would thus appear, and I think we are justified in holding this view, at any rate provisionally, that the result of continued selection will be to diminish the variability of a species; and if carried far enough, to produce a race with so little variability, and so closely adapted to its surroundings, that the slightest alteration in the conditions of life will cause extinction.*

If selection tends to diminish the variability of a species, then it clearly follows that as selection has been by hypothesis the most important means of modifying organisms, variation must have been much greater in past times than it is now. In fact it must have been progressively greater the farther we go back from the present time.

The argument which I have just laid before you points, if carried to its logical conclusion—and I see no reason why it should not be so carried—to the view that at the first origin of life upon the earth the variability of living matter consequent upon the act of conjugation must have been of enormous range; in other words, it points to the view that heredity was a much less important phenomenon than it is at present. Following out the same train of thought, we are inevitably driven to the conclusion that one of the most important results of the evolutionary change has been the gradual increase and perfection of heredity as a function of organisms and a gradual elimination of variability.

This view, if it can be established, is of the utmost importance to our theoretical conception of evolution, because it enables us to bring our requirements as to time within the limits granted by the physicists.

*The expression extinction of species seems to be used in two senses, which are generally confused. Firstly, a species may become modified so that the form with which we are familiar gradually gives place to one or more forms which have been gradually produced by its modification. That is to say, a character or series of characters becomes gradually modified or lost in successive generations. This is not really extinction, but development. Secondly, a species may gradually lose its variability, and become fixed in character. If the conditions then change, it is unable to adapt itself to them, and becomes truly extinct. In this case it leaves no descendants. We have to do with death, and not with devel pment.

If variation was markedly greater in the early periods of the existence of living matter, it is clear that it would have been possible for evolutionary change to have been effected much more rapidly than at present—especially when we remember that the world was then comparatively unoccupied by organisms, and that with the change of conditions consequent on the cooling and differentiation of the earth's surface, new places suitable for organic life were continually being formed. It will be observed that the conclusion we have now reached, viz, that variation was much greater near the dawn of life than it is now, and heredity a correspondingly less important phenomenon, is a deduction from the selection theory. It becomes, therefore, of some interest to inquire whether a suggestion obtained by a perfectly legitimate mode of reasoning receives any independent confirmation from other sources. The first source of facts to which we turn for such confirmation must obviously be paleontology. But paleontology unfortunately affords us no help. The facts of this science are too meagre to be of any use. Indeed, they are wanting altogether for the period which most immediately concerns us—namely, the period when the existing forms of life were established. This took place in the prefossiliferous period, for in the earliest fossiliferous rocks examples of almost all existing groups of animals are met with.

But although paleontology affords us no assistance, there is one class of facts which, when closely scrutinized, do lend some countenance to the view that when evolutionary change was at its greatest activity, *i. e.*, when the existing forms of life were being established, variation was considerably greater than it is at the present day.

But as this address has already exceeded all reasonable limits, and as the question which we are now approaching is one of very great complexity and difficulty, I am reluctantly compelled to defer the full consideration and treatment of it to another occasion. I can only hope that the far-reaching importance of my subject and the interest of it may to some extent atone for the great length which this address has attained.

Adam Sedgwick.

Cambridge University.

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*THE PROTEIDS OF LIVING MATTER.**

Of all the phenomena of nature vital phenomena have always appeared to the human mind the most complicated and intricate, so much so that even many scientific men have ascribed them to an inexplorable cause—the so-called vital force. This 'vitalism' is adhered to by many even today. In scrutinizing the various vital phenomena we observe, however, a great difference in the degree of complexity. There are on the one hand actions of an admittedly purely chemical, physical, and mechanical nature; and on the other those of organization, genetic differentiation, and of irritability on which differences of opinion still exist. The former appear of relatively simple character compared with the latter, which seem to offer difficulties of explanation insurmountable for science in its present state of development.

Protoplasm even of the simplest cells represents a highly complicated machinery. The organization corresponds to the construction of a machine, while its motive power consists in various forms of energy. Hence, two principal questions arise: (1) How is the machinery constructed? (2) What is the nature of the primary energy moving the machinery? The latter question is of a simpler kind than the former. We

* A paper read before the joint meeting of the Biological and Chemical Societies of Washington, May 5, 1900.

know that cells produce heat by the process of respiration (some of the lowest forms of fungi also by fermentative action) and that this heat energy is necessary for carrying on the various functions of life, for which purpose it can be transformed into chemical, electrical and mechanical energy in the cells. But how are the cells enabled to bring on the active oxidation phenomena that characterize the respiration process, and by what special contrivance can the heat energy thereby produced be converted into other forms of energy?

The conception of the nature of living protoplasm has changed with the progress of time. Formerly and by some authors even at the present time, it was defined as a changing mixture of different substances and all compounds found in the protoplasm were considered indispensable and intrinsic parts of it. Compare for instance, the publications of Reinke on the protoplasm of *Æthalium septicum*. Recently also Verworn has returned to this old conception.

But such a view cannot be logically entertained when we see that a certain protoplasm does continuously the same kind of work like a mechanism of a fixed structure. This mechanism consists here in a specific structure built up of easily changeable proteins requiring a certain amount of water and mineral salts. The amount of imbedded material, however, may continuously change. This material consists either of thermogens, as fat and sugar, or of mere by-products of metabolism which are soon excreted after their formation, either to the outside or into the vacuole.

What kind of work will result? it depends upon the configuration* and the specific chemical structure of these protein molecules on the one hand, and upon the specific construction of the machinery on the other. Thus, the protoplasts of the various vegetable and animal glands resemble just as many different chemical laboratories; the protoplasm of the muscular fibers severs molar motions; that of the nerves is especially adapted to conduct impressions by irritation to considerable distances. But the most complicated differentiation governs the structures of the nuclei of the generative cells, the most intricate laws rule the genetic differentiations in the development of an organism.*

From the chemical standpoint our first inquiry is directed, as already mentioned, to the question: *What causes the respiration-process of the cells?* What enables the proteins to cause the active oxidations of fat and glucose as long as the cells are alive, and why do these oxidations cease as soon as the cells are killed? Oxidation is a purely chemical phenomenon; hence, this question is of a plain chemical nature. Some might claim that by the death of the cells the organization is destroyed and this is the cause of the stoppage of the oxidation. But this view cannot be upheld, since even the most complicated machinery cannot produce work without the impelling energy. There must also be a certain amount of energy at the bottom of the respiration itself, there must be some energy for kindling the fire of the locomotive. What is this energy that leads to respiration? There remains no other answer than this: *It is chemical energy caused by the specific nature of the proteids of the living protoplasm which nature changes in the process of dying.*† Nu-

* The relative position of atoms in space.

* Nucleo proteids form the framework of the nucleus and of the cytoplasm and may exist in innumerable isomeric forms, of which the stereo-isomeric forms probably are of great importance as regards the differences between species. The word *proteid* is used here to designate the complicated compounds of proteins, such as nucleins, hæmoglobin, mucin, while the word *protein* comprises all kinds of albuminous matter in a general sense.

† A chemical change in the proteins of the living matter in the dying process was assumed as early as 1837 by John Fletcher and again in 1875 by E. Pflüger. But even at the present day many physi-

merous compounds are known which very easily undergo a chemical change; modern chemistry defines them as *labile* (unstable) compounds. Sometimes influences of a very subtle nature suffice to cause migration of the atoms in labile position to a more stable position whereby an isomeric and more stable product results.

I have repeatedly pointed out that we must distinguish between potentially labile and kinetically labile compounds; in other words, between static labile and dynamic labile.* To the former belong for example, the explosive organic compounds, as nitroglycerole or certain diazo compounds, to the latter aldehydes and ketones.† While the former are destroyed by chemical changes either totally or partially, the latter furnish numerous derivatives with great readiness, or change easily by atomic migration or by polymerization into isomeric or polymeric compounds. Many highly interesting cases of chemical change by atomic migration within labile molecules are known, but reference needs here be made only to one of the simpler instances—the change of ammonium cyanate into urea which is accomplished by merely heating the aqueous solution of the former.

Ammonium cyanate. Urea.

$$O:C:N.NH_4 \quad \text{becomes} \quad O:C\begin{matrix}\cdot NH_2\\ \cdot NH_2\end{matrix}.$$

This transformation is also of interest from another point of view, as being the first synthesis of an organic substance, accomplished by Woehler in 1828.

The analogy of living matter to dynamically labile compounds is also elucidated by the action of many poisons. Prussic acid, diamidogen, hydroxylamine, have in moderate dilutions at the ordinary temperature no action whatever on dead protoplasm or on the ordinary proteins, while they change living protoplasm very easily to dead protoplasm, a change induced by a chemical attack, labile compounds being more easily attacked by chemical agents than stable ones.*

The principle of chemical lability has not yet been the object of close investigation even by chemists, while physiologists have ignored it altogether, and this may be the reason that the necessity for assuming a chemical difference between the proteins of the living and of the dead protoplasm has not found due consideration, although this distinction is absolutely necessary for comprehending the *chemical* properties of living protoplasm. The free chemical energy due to the labile character of the proteids in the living protoplasm leads to respiration and since this energy cannot be produced after those labile proteins have changed to stable ones, respiration must cease also at the moment of death. The heat produced by respiration increases still further the oscillations of the labile atoms in the plasma proteins, in other words, it increases the charge of chemical energy, and the most complicated chemical work can now be carried out, the specific construction of a protoplast determining the kind and direction of the work. The maintenance of the respiration process is just as little due to a con-

ologists adhere to the old opinion of chemical identity of proteins in the living and dead protoplasm.

* The potential chemical energy in this discussion does not refer to the energetic relation of the compound to others, as in combustion, but to the intramolecular relation between the atoms of the compound itself. We may distinguish this as intramolecular potential chemical energy.

† The enzymes also belong to the dynamically labile compounds, as I have pointed out in SCIENCE, December, 1899.

* A systematic toxicological review shows us among other things that all compounds acting upon aldehydes and all that easily attack labile amido-groups are poisonous for all kinds of living protoplasm which fact led me to infer that the lability of the plasma proteids is caused by the presence of aldehyde and amido-groups within the same molecules. Compare: A natural system of poisonous actions, Munich, E. Wolff, publisher.

tinuous self-decomposition and regeneration of protoplasm, as Pflüger and Detmer assume, as to a previous activifying of oxygen as various other authors had supposed; but, as I have repeatedly pointed out, to an '*activifying of the thermogens*' by a charge with chemical energy from the protoplasm. An activified oxygen (ozone) or also hydrogen peroxid would kill the protoplasm sooner than it would burn up fat and sugar to carbonic acid and water. Indeed, nature has provided every living cell with a special enzyme which decomposes rapidly any trace of hydrogen peroxid that might make its appearance as a by-product in the active course of the cellular respiration.†

Other functions than chemical ones, as for instance the intricate phenomena of karyokinesis or the remarkable differentiation into ectoderm, entoderm, and mesoderm, or the differentiation of nervous fibers, although they are still very mysterious, also depend primarily upon the labile nature of the proteins. Not the slightest advance towards an understanding of these phenomena can be expected when this is disregarded.

The *primum movens* in the living protoplasm must be defined as a mode of motion of labile atoms in the plasma proteins; that is, as a *special case of chemical energy*. Living protoplasm has often been compared to a watch and dead protoplasm to a watch whose machinery has been destroyed by crushing, but this comparison is not a proper analogy, for, while the *chemical* character of the watch material remains unchanged after pulverizing, that of the dying protoplasm does not, but it undergoes a *chemical* change.

These deductions must necessarily lead to the further question: Is there any evidence of labile proteins existing before the organization into living matter is accomplished? Is any not yet organized forerunner of living protoplasm found in cells? Investigations of Dr. Th. Bokorny and myself carried on for a number of years have demonstrated beyond a doubt that there indeed occurs in many plants a reserve protein matter of highly labile nature, different from all other reserve proteins. It undergoes a great change under the same conditions that cause the death of the protoplasm itself, although more slowly. It seems logical to conceive this as the material which, by being converted into organized nucleo proteids, forms the living matter. The ordinary proteins must be brought first into the labile easily changeable condition before they can serve this purpose. We designated that labile reserve protein as active albumin or proto-protein, in contradistinction to the passive reserve proteins.

This peculiar, easily changeable body is met with in certain groups of plants very frequently, as in Julifloræ, Cystofloræ, Æsculineæ, Saxifragineæ, Myrtifloræ, and Rosifloræ, while in others rarely, as in Compositæ, Labiatæ, Leguminosæ, and Gramineæ, in fungi and in algæ. *Spirogyra* forms an exception with the algæ, inasmuch as this special group contains often very large quantities of the labile reserve protein. The widespread occurrence of this substance may be inferred from the fact that of 250 species examined by Th. Bokorny, G. Daikuhara, and myself, fully 120 were found to contain it in one part or other.

Of special objects rich in this proto-protein may be enumerated: Leaves of *Prunus*, *Rosa*, *Quercus*, *Alnus*, *Mimosa*, *Pæonia*, *Saxifraga*, *Sedum*, and *Cephalotus*, the bark of *Prunus*, *Quercus*, and *Fagus*; petals of *Gentiana*, *Primula*, *Sorbus*, *Cyclamen*, *Hotteia*, and *Cornus*; stamens of *Eugenia*, *Drosera*, and *Melaleuca*; pistils of *Crocus*, *Salix*, *Euphorbia*, and *Rhododendron*; nectaria of *Passiflora*;

† A detailed description of this enzyme will be given in a special Bulletin of the U. S. Dep't of Agriculture. A preliminary note appeared in SCIENCE recently.

roots (epidermis) of *Saxifraga*, *Œnothera*, *Xanthoxylon*, and *Thesium*; fruits (epidermis) of *Punica* and *Camellia*. In the roots and fruits it seems to occur less frequently than in leaves and flowers, especially frequent is the occurrence in the epidermis and the fibro-vascular tissue.* Leaves in the shade contain less than those exposed to light, while leaves with partial albinism may contain in the white parts as much as in the green. In plants exposed to starvation by being kept in darkness it is gradually consumed with production of amido compounds.

It is generally stored up in the vacuole, but in some cases also in the cytoplasm. The method of proving its presence consists in the application of dilute solutions (0.5%) of weak organic bases as caffeine and antipyrine. These can easily enter the cells without killing the protoplasm immediately and can separate the active albumin in form of little globules which coalesce gradually to larger bright droplets whose changes by various reagents can easily be followed under the microscope.

Generally it will suffice to place small pieces of vegetable tissue in a few drops of caffeine solution and then tear them up into finer fragments by the aid of dissecting needles. In other cases it is preferable to let the caffeine solution act for a number of hours. These globular formations were designated by us as proteosomes. When the objects soon after the formation of the proteosomes are replaced in water the droplets will gradually disappear again in proportion as the caffeine or antipyrine leaves the cells again by osmosis. Return of the objects to the former solutions makes the droplets reappear. When, however, the cells die gradually or are killed by iodine solution or acids in high dilution, or by formaldehyde, hydroxylamine, diamidogen, prussic acid, free cyanogen, or salts of copper, or by vapors of ether, these droplets change their properties, becoming vacuolized, insoluble, and solid. Generally they become at first turbid from innumerable little vacuoles which in most cases unite soon and form one large vacuole, thus producing a hollow sphere representing itself under the microscope as a ring. If now the objects are placed again in water these changed proteosomes will not dissolve as they did before. The coagulation by heat is easily observed on dipping the objects in boiling water containing 5 per cent. of sodium chlorid. A change somewhat different is brought on by highly dilute ammonia of 1 per mille or less, inasmuch as the proteosomes thereby shrink and solidify but generally do not vacuolize as in the above cases.*

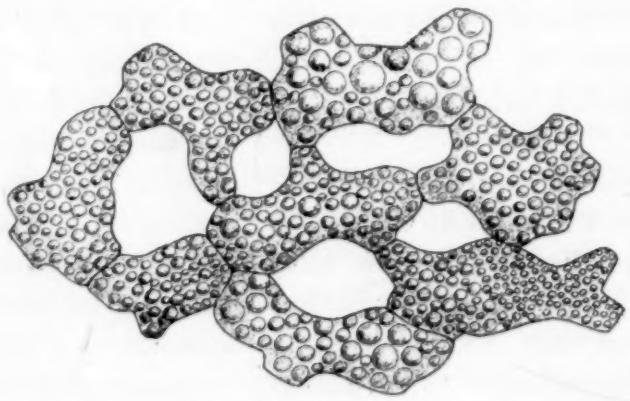

Fig. 1.

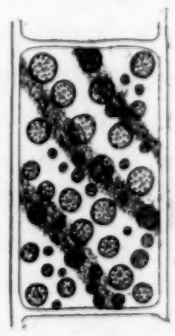

Fig. 2.

Fig. 1. Subepidermal cells of the lower side of the leaf of Echevera, after treatment with caffeine.

Fig. 2. Cells of Spirogyra treated with caffeine. The proteosomes produced show beginning vacuolization.

* Especially noticeable is the large amount present in insectivorous plants, *Utricularia* alone being devoid of it. In Cephalotus the large amount is especially remarkable. *Drosera* shows it not only in the leaf but also in stem and flower.

* A full description of the proteosomes is given in Chapters 9 and 10 of my treatise: 'Die chemische Energie der lebenden Zellen,' Munich, 1899. E. Wolff, publisher.

In dead cells caffeine never produces proteosomes. If we treat *Spirogyra*, which is an excellent object for studying the behavior of the proteosomes, for one minute with a dilute solution of iodine in potassium iodide the globules may still be produced immediately afterwards but not after ten minutes. It can easily be shown that the substance has not passed to the outside by osmosis, since the liquid surrounding the treated algæ does not show any reaction with caffeine. Various tests proved that the proteosomes consist of protein matter, but in most cases there are impurities present, especially tannin, a fact which has misled Pfeffer and some of his students so far as to assume these proteosomes to be merely compounds of tannin with common albumin and with caffeine. It is evident that such compounds would not exist in two different modifications and would not change their entire behavior with the death of the cells as above described. Pfeffer's objections are untenable, as repeatedly demonstrated. He has, for example, assumed that on the death of the cells certain compounds leave the protoplasm and upon entering into the vacuole cause there a change of the proteosomes. But it is easy to convince one's self that proteosomes can also often be produced in the cytoplasm itself, especially in the case of *Spirogyra*. Since these proteosomes remain in the cytoplasm also unchanged so long as the cells are alive, the assertion of Pfeffer is groundless. He has also argued that the phenomenon in question, viz, the production of proteosomes, may be due to the neutralization of the acid cell sap, but we have shown that the cell sap of *Spirogyra* has no acid reaction* and nevertheless it yields frequently numerous proteosomes.†

It is to be regretted that many plant physiologists rely upon the declarations made by some 'authority' instead of forming their own opinion from an unbiased critical investigation. The history of science shows that erroneous conceptions are often sustained for a long time in scientific circles simply because a man of a certain influence has defended them. The recognition of the genuine respiration of green plants furnishes a good illustration to this remark. Liebig, by weight of his authority, wiped out this truth for 20 years from science.

OSCAR LOEW.

U. S. DEPARTMENT OF AGRICULTURE.

* Botanische Zeitung, 1884.

† A careful observer will not confound these easily changing proteosomes produced only in living cells (as Dr. Albert F. Woods has suggested) with other globular masses produced by hypochlorite of soda upon the protoplasm of dead cells. Such formations and their distinction from proteosomes were described by Woods in SCIENCE, April, 1899.

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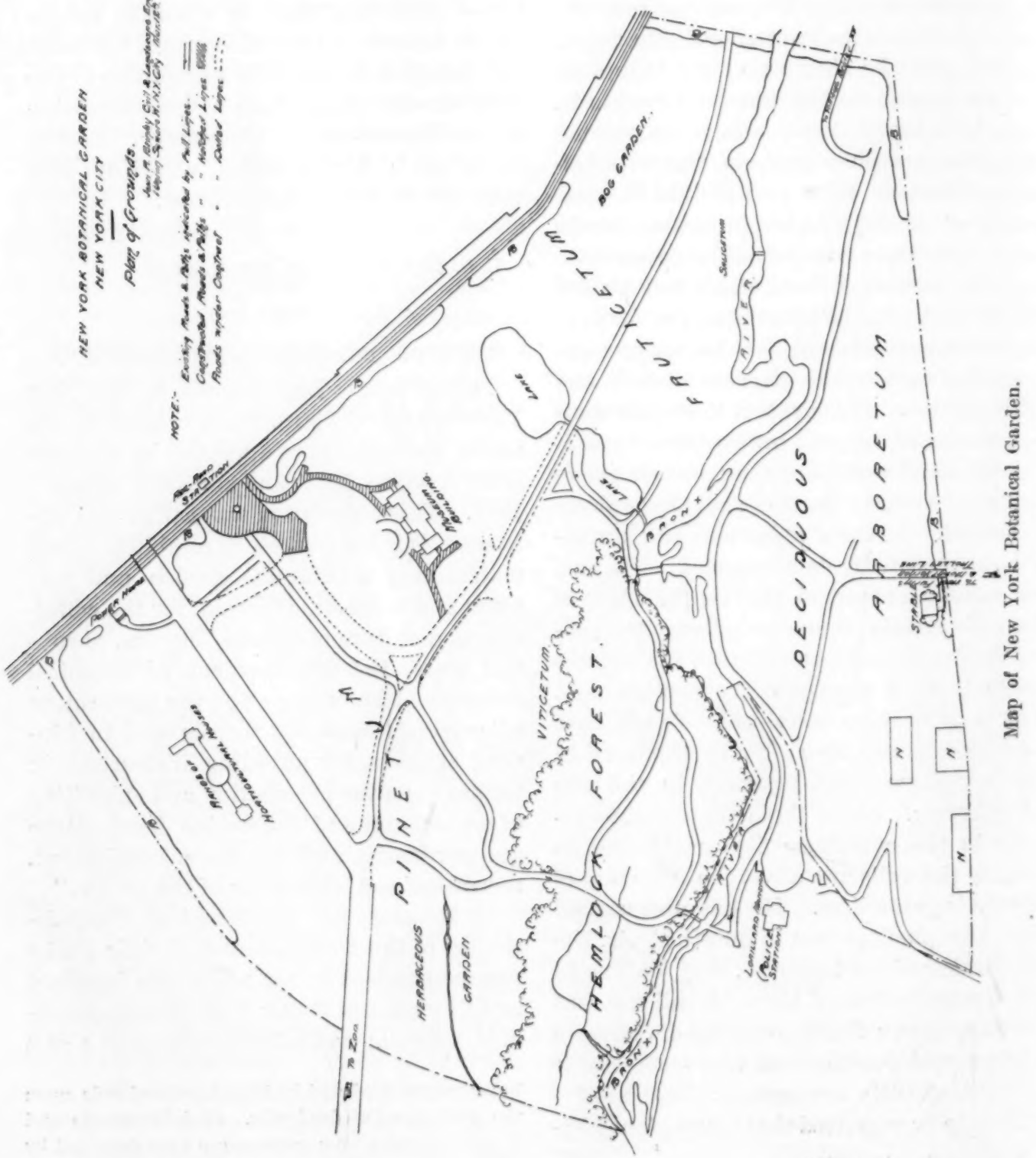
## *THE NEW YORK BOTANICAL GARDEN.**

THE corporate body known as the New York Botanical Garden was created by an act of the legislature approved by the governor April 28, 1891, and amended March 7, 1894. This association was called into existence "for the purpose of establishing and maintaining a botanical garden and museum and arboretum therein, for the collection and culture of plants, flowers, shrubs and trees, the advancement of botanical science and knowledge, and the prosecution of original researches therein and in kindred subjects, for affording instruction in the same, for the prosecution and exhibition of ornamental and decorative horticulture and gardening, and for the entertainment, recreation and instruction of the people."

By the same act the Board of Commissioners of the Department of Public Parks were authorized to set aside two hundred and fifty acres of Bronx Park, and erect suitable museum and other buildings at a cost

* Written by the request of the Editor of SCIENCE. See also article on same subject by author in the *Popular Science Monthly* for June, 1900.

of not more than five hundred thousand dollars on condition that the corporation should raise the sum of two hundred and




Map of New York Botanical Garden.

fifty thousand dollars within seven years. After the completion of the buildings these were to be handed over to the corporation by the Act was completed, and the land was set aside in 1895.

The active work of organization of the

Garden was begun in 1896, and Dr. N. L. Britton was elected Director-in-chief in that year. The perfecting of the plans for the buildings, roads, driveways, walks and plantation occupied the greater part of the attention of the management during this year and the next. The actual erection of the most important of these structures, the museum building, was begun in the Spring of 1898, ground having been broken for it late in 1897, and it was handed over to the board of managers of the Garden in March, 1900. During this constructive period many additions were made to the staff, and a large amount of material suitable for the museums was accumulated, while much progress has been made in the building of driveways and the development of the plantations.

The area included within the Garden has been, and will be freely accessible to the public at all times, for the enjoyment of the beauties of the wild woodlands, and of the collections of living plants, but the completion of the museum and horticultural houses marks the beginning of the full activity of the institution and a brief description of the manner in which it discharges its chief functions may be of interest.

The collections of living and prepared plants in the plantations and museums are arranged to present information on the form, relationship, mode of life, habit, and general biological characters of the principal types of vegetation in such manner as to be capable of comprehension by persons unacquainted with the technical aspects of botany. A number of special groups of plants have been established in suitable places in the Garden. The trees are in the arboretum of the Bronx on the side and summit of a long ridge; unassorted and reserve material of all kinds is kept in the nurseries on the eastern slopes of the same ridge; the salicetum is established on the border of a marsh in the northern end of the Garden giving the willows and poplars the conditions under which they grow best. The fruticetum occupies an adjoining upland plain, affording space for the cultivation of a large number of shrubs, while the conifers are located on slopes to the westward of the hemlock forest. The viticetum is along the western edge of the forest, and the trellises of logs and timbers extending for a length of six hundred feet give suitable support to the vines. The herbaceous collection occupies an open glade to the westward of the forest and lies between two granite ridges. It is traversed through the middle by a small stream widened at places into lagoons for aquatic forms. About twenty-two hundred species are now in cultivation in this plantation. The wide border plantations which are established along the boundaries also offer opportunities for the growth of a great variety of trees, herbs and shrubs, and serve as screens and supplementary nurseries.

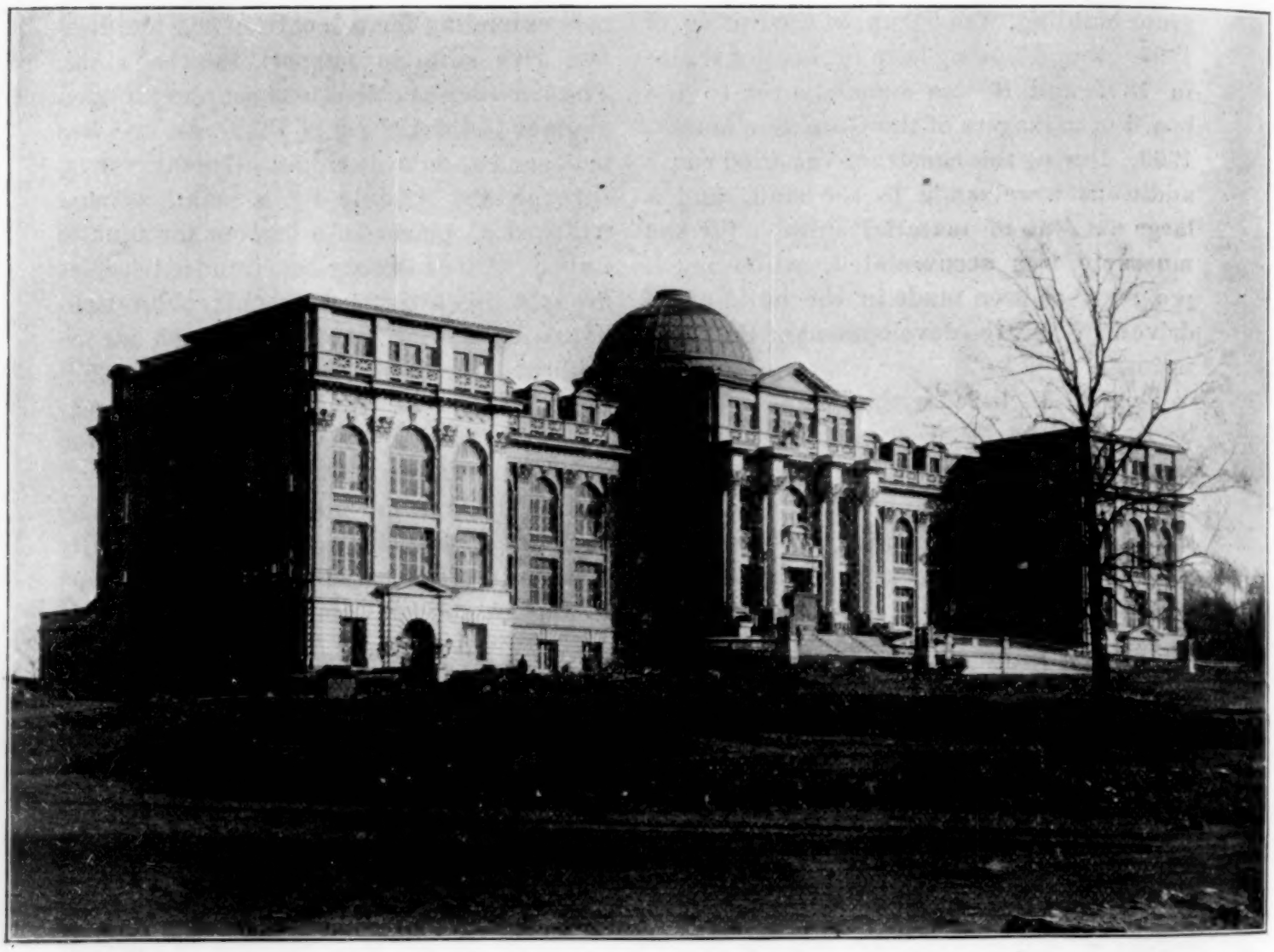
The horticultural houses, also erected by the city for the Garden and now essentially completed are located in the western part of the grounds at some distance from, and facing the museum. A palm house with a total height of dome of ninety feet is the central feature from which lower ranges extend on either side making a total length of front of five hundred and twelve feet.

The collections of living plants are arranged in the same system as the synoptic collection in the museum. Every plantation except the nurseries and boundary borders contains species of the same general habit, and the horticultural houses are used for the cultivation of forms which may not endure the outdoor climate of this locality. Not only will the plants from warmer zones be grown under glass, but when it is desired to develop native species out of their season they may be forced and brought to full development and bloom in the winter.

The museum is a fireproof building of brick, stone, and terra cotta, 308 by 110

feet, located in the western part of the grounds near the Bedford Park station of the Harlem division of the New York Central railroad. The building has a basement floor and three stories with a total floor area of nearly two acres, and window opening to half this amount, thus securing a good illumination, so highly desirable in a museum. A lecture theater occupies the basement floor of the western end, offering seating capacity for seven hundred hearers and furnished with all necessary appliances for the illustration of lectures. During the spring and autumn, courses of popular lectures are given on Saturday afternoons which have already drawn an attendance of from one hundred to five hundred. Adjoining the lecture hall are two large exhibition halls which are designed for horticultural shows and other temporary displays.

The first floor of the museum is devoted to the display of economic plants and their useful products. Glass fronted cases with movable and flying shelving are arranged in alcoves opening on the windows. Only about one-third of the case equipment of the building has as yet been set up. Dried specimens on herbarium sheets, conserved material in tubes, and jars, dry, and in formalin, and drawings, illustrate the method of preparation and appearance of the derivatives. It is of course utterly impossible



The Museum Building—New York Botanical Garden.

to demonstrate all the economic plants of the world or make even an approximately complete display within the space of a building, but the temporary installation now in place, represents many of the more important foods, drugs, timbers, woods, fibers, gums, waxes, resins, oils, sugars, starches, poisons, utensils, etc. The proper development of this collection requires a great amount of the most careful labor, and the curator has been fortunate in securing the co-operation of importers, producers, and manufacturers in the addition of exhibits.

The second floor contains a type exhibit of the vegetation of the globe arranged in families in the Engler and Prantl sequence. Specimens dry and in liquid preservatives, fruits, seeds, models, drawings and photographs are used to place the concept of the species before the observer. A set of hinged frames on standards contain the plants growing naturally within a hundred miles of New York City, and these are placed in their proper places in the series. Thus a case of the main series contains a representative of the family Violaceæ, and the frames near by display the local members of same family.

A number of microscopes of special design have been constructed for the purpose of displaying permanently the simpler and more minute organisms, or the structure of the higher forms.

The preparation of the material used in the exhibits is carried on in a number of rooms in the basement floor, and the members of the staff engaged in this work are assisted by a cabinet maker and printer.

The entire area of the Garden has been handled most sympathetically by those in charge of the architectural features of the Garden. The buildings were erected in the more open western part of the grounds, which offered the least valuable landscape features, and the surface around them has been improved by plantings. The natural beauties of the tract have been most zealously guarded from disturbances of all kinds. The attractive panorama of wild woodland and stream offered to the artist and lover of nature have been left absolutely untouched, but made more valuable by increased ease and safety of access. Thus to the general public, the Botanical Garden offers all the privileges enjoyed by them in the original park together with the interesting displays offered by the large special collections of interesting plants in the plantations and horticultural houses, as well as the exhibits in the museum. The increasingly large number of visitors attests the popularity of this feature of the institution.

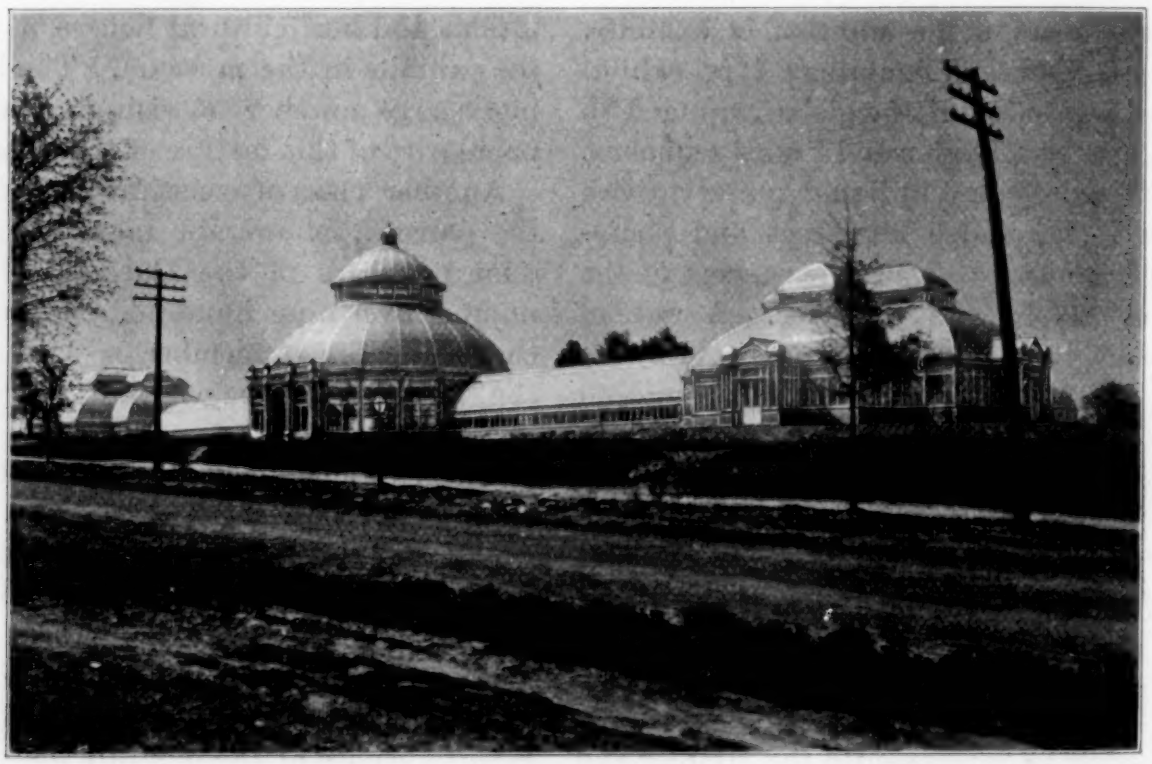
Another class of constituents consists of the patrons, fellows, life members and annual members of the Garden, who now number over nine hundred. A person becomes an annual member on invitation of the Board of Managers and payment of ten dollars per year, and enjoys certain privileges among which are: tickets to all lectures given under the auspices of the Board of Managers either at the Garden or elsewhere, invitations to all exhibitions given under the auspices of the Board of Managers, a copy of all handbooks published by the Garden, a copy of all annual reports, copies of the monthly *Journal*, and an opportunity to buy some of the other publications of the institution at reduced prices.

One of the most important functions of the Garden consists in the advancement of the technical knowledge of botany and the furtherance of research in all subdivisions of the subject.

The collections in the plantations, horticultural houses and museum offers an excellent melange of material upon which investigations may be based, and the herbarium, library and laboratories are the direct means for the facilitation of such research work. The Garden, as an indepen-

dent institution, offers its facilities to advanced students or investigators from any part of the world who may secure registration in the proper manner. Persons thus registering at the Garden are entitled to the privileges of a student at Columbia University without payment of further fees in accordance with the terms of a contract in existence between the two institutions. The essential features of this agreement stripped of formal verbiage are as follows: student may become a candidate at Columbia or other institutions of university rank.

Twenty-two students have had the privileges of the Garden during the collegiate year now closing. Eight of these were registered as students at the Garden and fourteen from Columbia. Two of these have undergone the examination for the degree of doctor of philosophy, and three for master of arts in Columbia University.



Main Horticultural houses: view from the northwest. New York Botanical Garden.

the herbarium and botanical library of the University are deposited at the Garden, the graduate work of the University in botany is carried on at the Garden under the guidance of a member of the staff of the Garden or of the University according to the election of the student: students registered at the Garden may elect work with members of either staff, and are entitled to the privileges of a student in other lines in Columbia University.

It is to be noted that the Garden is not enabled to confer degrees, but the advanced

The great diversity of natural conditions offered by the area comprised in the Garden, includes the widest range of cultural conditions, and in connection with the horticultural houses gives ample facility for work with living material. These advantages have already been realized in the cultural tests of critical or little known species, and in physiological experimentation.

The range of investigations which may be carried on in any institution is limited by its collections of living and preserved specimens and the accomplishment of re-

searches upon this material depends directly upon the facilities offered by its herbaria, library, and laboratories, and the spirit in which these opportunities are administered.

The main herbarium, library, and laboratories of the New York Botanical Garden are chiefly located on the third floor of the Museum and their arrangement is illustrated by the diagram in figure 4.

The main herbarium occupies a room eighty-five by forty-seven feet in the east wing, which is illuminated by four large skylights in addition to the windows. The plants are arranged in two parallel series of cases occupying opposite sides of the room, with large oak tables in the middle and at the ends of the room.

The Columbia University herbarium occupies the western side of the room, and "it is one of the oldest, and in itself one of the largest in America, contains over 600,000 specimens. This herbarium was begun early in the century by Dr. John Torrey, and contains the material upon which his classic botanical writings, extending over half a century, were based. Upon his death, 1873, this collection came into the possession of Columbia College. On this as a foundation the present Columbia herbarium was built. Mr. John J. Crooke presented two valuable collections to Columbia; the one, that of Professor C. F. Meisner, of Basle, Switzerland, one of the world's leading botanists, the other that of the late Dr. A. W. Chapman, of Apalachicola, Florida, in which are contained the specimens upon which Dr. Chapman founded his 'Flora of the Southern United States.' A few years later the mosses, and many of the hepatics and lichens accumulated by Mr. C. F. Austin, came into the possession of Columbia, while the latest acquisition of great size and importance, secured through the kindness of friends of the university, was the famous collection of mosses brought together from all parts of the world by the late Dr. J. G. Jaeger, of Switzerland. To this ample nucleus Dr. Torrey's successor, Dr. N. L. Britton, while professor at Columbia, and his associates, added continually by securing collections from all parts of the globe, and by special collecting trips to various parts of North America.

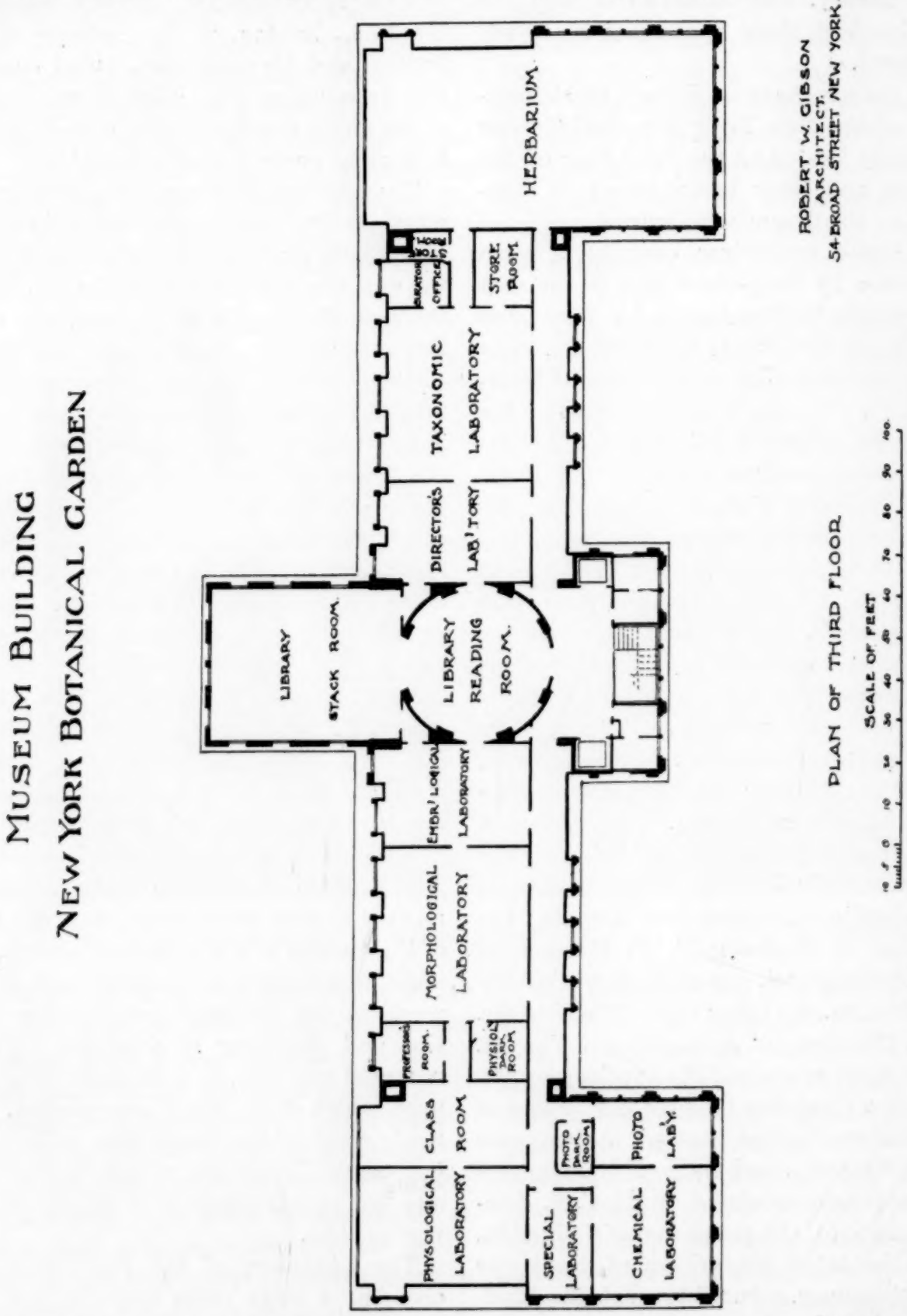
The most complete sets of specimens secured on two noteworthy South American journeys of exploration are here preserved; the one trip was that made by Dr. Rusby through the Andes of Bolivia, the other that of Mr. Morong in Paraguay and Chili."

The Garden has accumulated about 200,000 herbarium specimens since its organization. In this number is included the famous Ellis collection of fungi, including over a hundred thousand and forming one of the largest and most complete collections of fungi in the world, outranking any similar collection in America. Various private herbaria have been acquired by gift and purchase, among which are those of John J. Cooke, F. M. Hexamer, H. E. Hasse, P. A. Rydberg, Lewis R. Gibbes, Peter V. LeRoy, Harry Edwards, Anna M. Vail and Francis E. Lloyd. Accessions are being made at the rate of fifty to a hundred thousand specimens per year.

The main herbarium room is supplemented by two store rooms, and the office of the curator of the museums near it. In addition adequate preparation and storage rooms in the basement serve for the reception and handling of duplicate and unmounted material, as well as for the press upon which final labels are printed. Directly west of the herbarium suite is the taxonomic laboratory, which is especially adapted for systematic and anatomical investigations.

The laboratory of the Director-in-chief occupies a large room between the taxonomic laboratory and the library. The embryological laboratory occupies a cor-

responding position on the other side of the reading room, and opens into the main morward, and also receive indirect light from the hallway through numerous glass panels.




Plan of laboratories, libraries and herbarium, New York Botanical Garden.

phological laboratory. These laboratories are illuminated by windows facing north- The instrumental equipment of the laboratories comprises a number of microscope

stands suitable for investigators, from the most prominent makers, and a full complement of objectives, immersion and apochromatic. The outfit in question has been planned to meet the habits and prejudices of workers from any part of the country, and it has been found possible to duplicate the apparatus to which any student has become accustomed.

The construction for special furniture for the laboratories awaits the definition of the forms most suitable for the character of the work which may be undertaken here.

A most interesting comparison with the battery of modern high power optical apparatus on hand, is afforded by a collection of old microscopes given by Mr. Chas. F. Cox of the Board of Managers, which forms a special laboratory exhibit. This collection illustrates the development of the microscope during the last century and a half.

The physiological dark room opens from the morphological laboratory, and is fourteen feet square with double doors and independent ventilation, connecting directly with the outside air. It is heated indirectly by the walls of the contiguous rooms, and its position in the middle of the wing of the building together with its content of over thirty-five hundred cubic feet of air secure for it a very equable temperature. This room has been in constant use for six months including the period of tests of the heating system of the building and the total range of temperature has not exceeded four degrees centigrade, and at no time has a variation of two degrees been noted in a single week. The humidity varies from sixty to eighty per cent. in the work now in progress, and it has been found to offer much more suitable conditions for experimental work than any room used for a similar purpose which has come under the notice of the writer.

A corridor leads from the morphological laboratory to the class-room between the dark room and the office of the director of the laboratories (Professor's room, Fig. 4). The class-room is thirty-five by twenty feet, and one end is furnished with such accessories as to make it suitable for the weekly convention of workers from the laboratories. The other end serves for the private laboratory of the director of the laboratories and contains the departmental library.

The physiological laboratory is a skylighted room, thirty-five by thirty-two feet, occupying the corner of the building. It has a stone floor set in water-tight cement, a tank for aquatics, and tables for cultures. An ample heating surface is provided, and a special system of steam pipes around under the skylights secures ventilation, and acts as a preventive of dripping moisture. Ventilation of the ordinary type and that of the greenhouse are provided, while a set of shades may be used to cut off the direct rays of the sun. By such means a range of temperature similar to that of an intermediate greenhouse is secured. To this room are brought specimens from the plantations and greenhouses for experimental and observational purposes, and these are removed as soon as the work with them is finished.

A small chemical laboratory opens from the physiological laboratory, and leads into the large chemical laboratory occupying the corner of the wing. This room has not yet been provided with the special furniture and fittings necessary for chemical work. It has a large ventilating hood leading into a duct into which all the ventilating flues of the room empty. A ventilating fan driven by a powerful motor is capable of renewing the entire body of air in the room in a few minutes and thus preventing the escape of noxious gases into the contiguous laboratories.

The second corner of the wing is occupied by the photographic laboratory and

balance room, which is equipped with an outfit comprising a set of screens, cameras, and a selection of anastigmatic and planar lenses which provide for almost every contingency of indoor and outdoor work, including photomicrography and projection. The adjoining dark room opens directly into the hallway and contains the apparatus necessary for developing the printing.

The basement floor of the museum contains two rooms devoted to laboratory purposes. One is planned for the storage of chemicals and other supplies, for glassblowing and general preparation work. The second is a constant temperature room, thirty-four by twenty feet, furnished with double walls, doors and windows; this is designed to be separated into several smaller chambers in which different temperatures may be maintained. A series of thermographic tests of the temperature resulting from outside and inside causes are now in progress, from which the final fittings necessary for absolute control of the different temperatures may be determined.

The worker who comes to the herbarium or laboratories is supposed to have already demonstrated his ability to carry on independent research work, and after he has been provided with the necessities for the prosecution of the work he has only so much of advice and consultation with the member of the staff under whom he has elected work as to insure its successful prosecution. No facilities are given for elementary instruction. All the members of the staff and the workers in the laboratories meet once every week to listen to the presentation of results accomplished by one of their number, or by some visiting botanist. The opportunity for the discussion of newly found results has been found most stimulating to the persons concerned, and interesting to all attending.

The library consists of a large reading room or rotunda under the dome, of a stack or book room to the rear in the square central wing and two small store rooms for pamphlets and duplicates.

The stack room is admirably lighted by three west, four north and three east windows, and by a long central skylight. The reading room is lighted both from the windows in the dome and from the stack room, and is furnished with chairs and large oak tables.

The book stacks are forty in number, arranged along both sides of the book room. They are constructed by steel plate of one-tenth inch in thickness, are double-fronted, made in sections four feet long, two feet deep and six and a-half feet high, with solid ends and tops, but no fronts or doors, the lowest shelf being about three inches from the floor. They are painted a dark olive-green in japanned finish. Each stack is provided with five movable shelves with adjustable space or holes on the inside of the cases about one inch apart, through which small bolts are thrust to catch the shelves. For the folios there are four large metallic double-fronted cases, three feet high with a table top five by three and a half feet, in the center of the stack room. Each case has two sections on each front, one with three plain shelves and the other arranged with a system of roller shelves for the easier handling of the heavier folios.

In accordance with the agreement with Columbia University all the botanical books of this institution, amounting to about 5000, are deposited here. The Garden has acquired about 2000 volumes since its organization. The general character of the library may be known when it is stated that an invoice, February 1, 1900, showed 127 volumes of general dictionaries and non-botanical reference works, 100 volumes on general science, 200 volumes on geology and paleontology, 1733 volumes of periodicals and proceedings, 52 volumes of collective and historical works, 495 vol-

umes on morphology and physiology, 50 volumes on geographic distribution, 2105 volumes of floras and taxonomic monographs on the phanerogams, 900 volumes on cryptogams, 640 volumes on agriculture, 325 volumes on gardening, 200 volumes on forestry and 200 volumes on meteorology. The total number of volumes on the shelves was 7117. Since this count was made the additions raise the total to about 8000. Some care has been taken to exclude books and proceedings which have only an incidental interest to botany, with the idea that such additions decrease the actual working efficiency of the library and increase the labor necessary for its administration. The books are classified according to the Dewey system of indexing, and pamphlets and separates are not indexed or included in the count until bound up in volumes by subject.

The collective efficiency of the facilities described above is such that the institution bids fair to meet the expectations of all its different classes of constituents. The large number of specialists of the staff, together with those of other institutions who offer to guide research here, gives the student, who may come here to carry on investigations, the widest range of election of work. Among those offering to guide research in the Garden are: Professor L. M. Underwood, Dr. C. C. Curtis, Dr. M. A. Howe, Dr. N. L. Britton, Dr. D. T. MacDougal, Dr. P. A. Rydberg, Dr. G. V. Nash, Dr. J. K. Small, Professor F. E. Lloyd, Mrs. E. G. Britton, and Professor E. S. Burgess.

The personal interest and care shown by the members of the Board of Managers in the organization of the Garden has resulted in placing it on its present broad foundation, while the energetic administration of the business details by the Director-in-chief has brought the institution through the most critical part of its constructive period without departure from the original plans, without financial deficit, and with no undue loss of time.

The original guarantee fund has been preserved intact and increased by gifts and bequests to nearly $300,000, the income of which is available; a second source of income consists of the fees of the members, and a third source is the support received from the Department of Public Parks of the City of New York.

D. T. MACDOUGAL.

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## SCIENTIFIC BOOKS.

*The Unknown.* By CAMILLE FLAMMARION. Harper & Brothers. 1900. Pp. 488.

This volume consists of a plea for the existence of unknown or unrecognized psychical forces or manifestations, and an attempt to popularize this branch of investigation, by an astronomer who is known for similar contributions to other fields—some of them of a pronounced imaginative type. When one applies to the work the critical examination which science demands, the estimate of its value must be distinctly unfavorable. Its defects are many and serious; its merits do not go beyond those included in a laborious compilation of refractory material and a thorough and sincere interest. Its contents include two introductory chapters on the dangers of excessive incredulity as well as of a too ready credulity; a large collection of cases of communications made by the dying and regarded as evidence of telepathy; a similar collection of related cases of thought transmission and clairvoyance under other conditions; a consideration of dreams and of premonitions and of hallucinations, mainly again as indicative of abnormal psychic operations; and some scattered and weak attempts to interpret these phenomena on a telepathic and 'psychic force' hypothesis. The dominant tone of the book is one not uncommon in French writings of similar purpose, and one particularly unattractive to the Anglo-Saxon intellect; there is much protesting of the necessity of careful observation and of not accepting anything except on a sufficient evidence, and again of the limitations of human knowledge and of the readiness with which even

learned men make mistakes and form prejudices, and of the ultimate possibility of almost any theory and belief; there is much use of analogies without any discernment of the essential likeness or unlikeness upon which the value of all analogies rests; there is an attempt to write the matter up for and down to the public which when put into matter-of-fact and not too skillful English produces an unfortunate impression of self-assurance and an assumption on the part of the writer of an intense interest in his opinions on the part of the public.

Viewed as a contribution to a domain of knowledge most familiarly known as 'Psychical Research,' the work's fundamental faults are a lack of critical judgment in the estimation of evidence, and of an appreciation of the nature of the logical conditions which the study of these problems presents. In this respect it forms a marked contrast with the best of the English contributions to the same topics, notwithstanding an essential agreement of results. Although the motto of one of the chapters is 'Des faits! Pas de phrases,' the readiness of the author to accept as real fact the elaborated and often biased report of an unskilled witness, and to pay himself with words in his own use of the evidence, are lamentably conspicuous. A writer who can say of the reports of 4280 miscellaneous correspondents who reply to his request for cases of unusual 'psychic experiences'; "What struck me in all these narratives was the loyalty, good faith, frankness, and delicacy of the writers, who were careful to tell only what they knew and how they came to know it, without adding to or subtracting anything from the subject. Every one of them was the servant of truth," gives more evidence of his confidence in human nature than of his fitness to undertake such an investigation. A writer who can cite the persistence of sensations referred to amputated limbs, and the familiar principle of 'eccentric projection' that the sources of our sensations are referred outward to an external object, and the subjective character of color sensations, as psychological data suggestive of or corroborative of telepathy; who can transfer the physical principle of sympathetic vibration to imaginary brain vibrations and state that "All facts relating to the production and association of ideas can be explained by the occurrence of vibrations of the brain and of the nervous system which originates in the brain; this was demonstrated by David Hartley in the last century," gives further evidence of his incapacity for the task which he has elected to perform.

From beginning to the end of the volume there is no evidence that the author has considered or is familiar with the explanations of a non-telepathic nature which have been offered for some of the facts with which he deals. The fact that hypnotized subjects are quick to seize and act upon the unconscious wishes or suggestions of their hypnotizers is put down as evidence of telepathy without mention of other far more simple and more adequately demonstrated explanations; and the considerable evidence for regarding many 'veridical' presentiments and premonitions as illusions of memory is likewise ignored. Instead of a carefully developed logical argument, strengthened at every step by an examination of rival hypotheses and of the sources of error inherent in the evidence; instead of the critical analysis and differentiation of cases and a discernment of the prominent factors of community and divergence of the observations; we have only reiteration with increasing emphasis of the truth of the author's favorite hypothesis, and an endless compilation of stories that may be interesting and even significant but hardly justify the purpose to which they are applied. "Brains are centres of radiation." "But the actual FACT of the action of the soul at a distance is now demonstrated." "*The action of one human being upon another, from a distance, is a scientific fact; it is as certain as the existence of Paris, of Napoleon, of Oxygen, or of Sirius.*" "There are *mental transmissions, communications of thoughts, and psychic currents* between human souls." "PSYCHIC FORCE EXISTS. ITS NATURE IS YET UNKNOWN." "We may *see without eyes and hear without ears*, . . . by some interior sense, psychic and mental." "The soul by its interior vision, may see *not only what is passing at a great distance*, but it may also know in advance *what is to happen in the future.* The future exists potentially, determined by causes which bring

to pass successive events." If such statements as these are warranted by the evidence which is offered, then the logic of this science is not that of the other sciences.

The popular interest in the topic which this volume treats, the obvious intention to gain the ear of the public by recounting tales of merely personal interest and passing them off as scientific data, the confident expression of the author in the certainty of his conclusions, will all combine to circulate the notion among the public at large that the conclusions of the volume represent the final verdict of science on these momentous questions; and it is in this respect that the volume is likely to exert a seriously unfortunate influence. It is difficult enough at best to get the intelligent layman to understand that the ability to interpret soundly and rationally phenomena of this field demands, like all expert opinion, a special knowledge and a fitness of training and intellect. It is quite idle to expect the layman to distinguish too closely between one scientist and another, or between the methods which they use and the dicta which they express. Possibly (and it were better if one could say probably) M. Flammarion has so seriously overstepped the limits of sound judgment and expression in this matter, that his authority will be called into question by the reader who reflects as he reads. There is no good reason why an astronomer with a gift for popularization and an interest in the phenomena of the 'Unknown' should not prepare as good and valuable an account of these phenomena as the present state of knowledge permits. There is no desire on the part of psychologists to discountenance such investigation, whatever its origin. But it is essential that the investigator should thoroughly know what the present state of knowledge really is, and above all, that he should possess the indispensable logical appreciation of the conditions of the various problems.

This logical vigor and discernment, this essential logical insight that is both a natural endowment and the result of conscientious training is not the prerogative of any one science nor of scientists at large; and he who has it has the most important part of the equipment necessary to the participation in such investigations. It is because this volume is conspicuously lacking in these qualities, and because it as a consequence substitutes for them uncritical collections of narratives and dogmatically stated conclusions, that it must be disavowed by those who stand for the thoroughly scientific investigation of the unexplored regions of the psychological universe. It is very certain that if M. Flammarion and his colleagues had used the same methods in astronomy as he applies to the investigations of this volume, modern astronomy would be held in very different repute from that which it now enjoys. There is an amateur and an expert exploration of this field, just as there is in geographical exploration, and it will require the best trained and most scientific explorer to reveal the true nature of this 'darkest Africa' of the human mind.

JOSEPH JASTROW.

*Histoire des mathématiques.* Par JACQUES BOYER. GEORGES CARRÉ et C. NAUD, Éditeurs. Paris. 1900. Pp. 260.

The growing interest in the history of science is made manifest by the number of historical works which have appeared in recent years. Perhaps in no science is this movement so marked as in mathematics. During the last twenty years there have appeared not only the monumental works of Moritz Cantor and Maximilien Marie, but also a large number of brief histories. The volume before us belongs to the latter class.

An attractive feature of this book are the page-portraits of nineteen mathematicians and seven facsimiles of parts of celebrated manuscripts and of old drawings of mathematical instruments. We know of no other general history of mathematics which furnishes the reader such a treat. So high is our appreciation of this feature that we are ready to forgive the author when we discover that, out of a total number of nineteen mathematicians whom he has honored with portraits, eleven are Frenchmen.

M. Boyer's history is written in an interesting style and will doubtless stimulate more serious study of mathematical history in larger works. But in two respects the author has hardly achieved what might have been expected of him.

In the first place, the author has in several instances failed to embody the latest fruits of historical research. Thus, in connection with the graphical representation of imaginaries he fails to mention Wessel; in speaking of non-Euclidean geometry he refers to Saccheri, but not to Lambert and Taurinus; in tracing the history of trigonometry he apparently overlooked the researches of Suter and Braunmühl, who show that the Arabs distinguished themselves by original work much more than was formerly supposed; he makes no mention of the Bakhshali manuscript, which throws considerable light on early Hindu arithmetic. As a rule, the facts presented are stated accurately. Among the exceptions are the following: Athelard of Bath is mentioned as the first translator of Euclid from the Arabic into Latin, but there is ground for the belief that earlier translations existed. Boyer attributes to Benjamin Peirce a research which seems to be due entirely to Charles S. Peirce; he misspells the name of Crozet, the author of the first American text on descriptive geometry; he gives Antissa instead of Antinoeia as the birthplace of Serenus.

In the next place, the book is deficient because it does not trace the evolution of theories. Something on the growth of mathematical ideas we have a right to expect even in a short history. If the reader consults this work on the introduction of the notion of infinity or of continuity, on the evolution of the theory of limits, on the number concept, or on the foundations of algebra, he will receive little satisfaction. But these topics are all of vital importance in elementary as well as in advanced mathematics.

Florian Cajori.

Colorado College, Colorado Springs.

*Elementary Chemistry. For High Schools and Academies.* By A. L. Arey, C.E., Rochester (N. Y.) High School. New York, The Macmillan Co. 1899.

The author has adopted the theoretically ideal plan of forcing the student to note the various features of chemical reactions without any suggestion as to the phenomena which one is expected to observe. Very few students have cultivated and trained their power of observation, and one of the most advantageous purposes of the study of a science is to develop this side of their nature. This can only be done by teaching him what he sees and how he should see it and thus gradually training his powers of observation until he is able to observe new phenomena for himself and becomes independent of the observations of others. Several dangerous experiments are placed in the early part of the book with no notice of the precautions to be taken, and if this book was put into the hands of an inexperienced worker there would probably be disastrous results.

J. E. G.

*Laboratory Exercises with Outlines for the Study of Chemistry, to accompany any Elementary Text.* By H. H. Nicholson, Professor of Chemistry in the University of Nebraska, and S. Avery, Professor of Chemistry in the University of Idaho. New York, Henry Holt & Co. 1899.

This book is intended as a laboratory guide to be used in connection with a text-book. It is well arranged and the descriptions are clear and logical, and with conscientious use of a reference book should produce the desired results. In cases where dangerous materials are to be handled too much caution cannot be given. In exercise 3 the student is directed to rub in a mortar a piece of sulphur and a crystal of potassium chlorate the size of a grain of wheat. One who had never had experience with students just beginning the study of chemistry would be surprised at the differences of opinion as to the size of a grain of wheat.

J. E. G.

*School Chemistry.* By Chas. Baskerville, Ph.D. The University of North Carolina. Richmond, Va., B. F. Johnson Publishing Co. 1899.

The author wrote this book for use in summer schools for teachers. In attempting to cover the whole field in a short course he has prepared a work which will not give a student the necessary foundation either for teaching the elements of the subject or continuing its study with advantage. A few subjects thoroughly understood would probably be of more value than a little knowledge of many, so far as its use by the class of students for whom it is intended is concerned. The author has no doubt supplemented it by

valuable class and laboratory instruction as he reports its use for five years with success.

J. E. G.

*The Living Organism.* An Introduction to the Problems of Biology. By ALFRED EARL. London, Macmillan & Co. 1898. Pp. xiii + 271.

This book gives the too wordy reflections upon biological phenomena of an author who seems to have a fair general acquaintance with biological principles, but no very extensive knowledge of biological facts. The consequence is a book which is philosophical in form, discusses biological phenomena in an extremely general and abstract way, contains few errors, but, on the other hand, has little of suggestiveness for the advanced biologist. The style is flowing, but often obscure; and after reading a few pages one wearies of the pedantry which clothes well-known and simple ideas in a heavy blanket of abstract verbiage. Thus, the fact that organisms assimilate is put (in Italics) thus: "Both animals and plants depend for their continued existence upon certain material which is absorbed and changed in properties by contact with the living body." This is typical (p. 227): "The remarkable constancy of the living form, one of its distinctive signs, even when united in thought with the ceaseless occurrences tending to disturb that form, gives no positive indication of other than physical agents. Indeed, it is only by a just apprehension of everything that concerns or affects the organism, in other words, by a due regard to external changes as well to the more prominent activity of the organism, that it is possible to gain coherent knowledge of the fact known as life." We must conclude that the book contains little of importance for the working biologist.

C. B. DAVENPORT.

SUTER'S HAND-BOOK OF OPTICS FOR STUDENTS OF OPHTHALMOLOGY.

This little book, as its title implies, contains such small portions of geometrical optics as may be useful directly to a certain limited class of students. Like all fragmentary text-books, it suffers under the difficulties of such special treatment. Many important portions of the subject are omitted or barely mentioned, and only those are developed in detail which appertain directly to the object in view. Thus the introductory and general portions, including the general treatment of refraction, are condensed almost to obscurity, and, considered as demonstration, are incomplete. Refraction through spherical surfaces is much more satisfactorily handled, and is succeeded by an excellent chapter on lenses, following in general the methods of Gauss. In both these chapters the use of algebraic signs is somewhat arbitrary and inconsistent. The principles thus expounded are then applied to the eye as an optical instrument, both in its normal condition, and in connection with the spectacle lenses used to correct its errors of refraction. These chapters form, as was to be expected, the most important part of the book. They are clear and instructive, and well illustrated by numerical examples. They are followed by discussion of cylindrical lenses, and prismatic glasses. The final chapters on the ophthalmoscope are too brief to be of great practical benefit.

The whole presentation of the subject is adequate to its immediate purpose, though the rare student of ophthalmology who has enough interest in the optical side of his work really to profit by this book would find it much more to his advantage to read instead a larger and more complete treatise.

FRANK P. WHITMAN.

BOOKS RECEIVED.

*Memoirs Presented to the Cambridge Philosophical Society on the Occasion of the Jubilee of* Sir GEORGE GABRIEL STOKES, Bart, Hon, LL.D., Hons. ScD. Lucasian Professor. Cambridge, at the University Press; New York, The Macmillan Company. 1900. Pp. xxviii + 447 and twenty-five plates. $6.50.

*Papers on Mechanical and Physical Subjects.* OSBORN REYNOLDS, F.R.S. Cambridge, The University Press; New York, The Macmillan Company. 1900. Vol. I, pp. xv + 416. $5.00.

*An Introduction to the Study of the Comparative Anatomy of Animals.* GILBERT C. BOURNE. London, George Bell & Sons; New York, The Macmillan Company. 1900. Vol. I, pp. xvi + 269. $1.10.

*Zoological Results,* based on material from New Britain, New Guinea, Loyalty and elsewhere, collected during the years 1895, 1896 and 1897. ARTHUR WILLEY. Cambridge University Press;

New York, The Macmillan Company. 1900. Part IV, pp. viii + 354-530, plates xxxiv–liii. 21s.

*Biological Lectures from the Marine Biological Laboratory at Woods Holl, 1899.* Boston, Ginn & Company. 1900. Pp. 282.

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## *SCIENTIFIC JOURNALS AND ARTICLES.*

*The American Naturalist* for May, opens with a detailed account of 'Marine Biology at Beaufort,' by H. V. Wilson, calling attention to the advantages of this locality as a field of research. J. G. Needham describes 'The Fruiting of the Blue Flag (*Iris versicolor* L.)' noting the effect of civilization in altering its environment. Chas. W. Hargitt presents 'A Contribution to the Natural History and Development of *Pennaria tiarella* McCr.' and R. W. Shufeldt reviews 'The Ornithological Results of the Polar Expedition under Dr. Nansen.' The ninth part of 'Synopses of North-American Invertebrates' is by Nathan Banks, and is devoted to 'The Scorpions, Solpugids and Pedipalpi.' There are numerous reviews of recent literature.

*Bird Lore* for June has for its leading article, a comparison of 'Song Birds in Europe and America' by Robert Ridgway, which is very favorable to our native birds. William L. Baily describes 'The Kingfisher's Home-Life,' with illustrations of the young at different ages, and Laura G. Page has an article on 'Swallows and Feathers.' Florence Merriam Bailey tells 'How to Conduct Field Classes,' and there is a notice of the course of 'Bird Study at Wood's Holl Marine Biological Laboratory.' There are some interesting notes, and in the Audubon Department an important agreement of the members of the Millinery Merchants Protective Association regarding the importation, manufacture and sale of North American birds, by which the Association agrees not to use any more North American birds after the stock on hand is exhausted, in return for which the Audubon Society and Ornithologists Union are to do everything in their power to prevent the passage of laws interfering with the manufacture and sale of ornaments made from the plumage of barnyard fowl, edible birds, game in season and foreign birds.

## *SOCIETIES AND ACADEMIES.*

### THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy of Science of St. Louis on the evening of May 23, 1900, the following subjects were presented:

A paper by Dr. Adolf Alt, entitled 'Original contributions concerning the glandular structures appertaining to the human eye and its appendages,' was presented by title.

Dr. M. A. Goldstein read a paper on 'The physiology of voice production,' in which he discussed three essential factors in the production of voice: the motor force, the organ of sound, and the resonators. The essential features presented may be summarized as follows: (1) All elements carefully considered, the best form of breathing applicable to voice production and singing is the rational combination of the costal with the diaphragmatic type. Reserve force in breathing is best attained by deep inspiration, fixation of the distended diaphragm and thorax, and control of these muscles while tone is produced. (2) To facilitate vocalization, the larynx should never be tightly contracted by the muscles of the throat, especially in the production of the registers. (3) On the resonating cavities, their proper conformation and position in relation to the vibrating cords and larynx, depend the quality and timbre of the voice, so that the careful and proper placing of tones is perhaps the most essential factor in voice production.

Professor F. E. Nipher read a short communication on the zero photographic plate, to which reference was made at the meeting of May 7th, and in his paper published as Vol. X., No. 6, of the Academy's Transactions.

The zero plate is one upon which a photographic image has been made, but which will develop no image in a bath placed in light of given candle power, at a distance of one meter from the source. For example, if the developing bath is twenty centimeters from a sixteen candle lamp, a Cramer isochromatic plate, such as is called 'instantaneous,' held for ninety seconds at a distance of one meter from the lamp, will be a zero plate. With an opaque stencil over the plate when placed in a printing frame, during the exposure, there will develop a positive of holes through the stencil, if the

exposure is longer, and a negative if the exposure is shorter. The bath used in the above illustration must be weak and cool.

If a fresh plate is exposed in our camera with full opening to a brilliantly lighted street scene for one minute, it will develop as a positive in that same bath. This time can be somewhat reduced, but the least time needed has not yet been determined. It is evident that part of this minute is used in producing a zero plate. It is furthermore clear that different parts of the plate will arrive at the zero condition at different times. The exposure may be arrested at a time when the strongly lighted white background of a sign-board will develop white as a positive, and when the black letters will also show white as a negative.

It has been found that when a plate is uniformly exposed over its whole surface to the extent that nothing would have developed had it been covered by a stencil, this plate may then be placed in a camera and exposed in the ordinary way, and a perfect positive will develop in the bath to which it has been adapted. This preliminary spoiling of the plate for developing a negative is a very advantageous preparation for taking a positive. It shortens the time of exposure, and ensures that a positive shall be obtained over all parts of the plate. It is not yet known how short the camera exposures may be made, but the present indications are that they will be as short as those now made in the taking of negative pictures.

It is currently believed by photographers that in a positive plate the object has 'printed its picture' upon the plate. This is an entire misconception of the process. It is true that in an exposure of long duration an image shows on the plate before it is placed in the bath. But this image is blackest where the light has acted most. It is a negative. This picture disappears in the developing bath when illuminated. The plate becomes perfectly clear. The positive picture then develops, exactly as a negative would under ordinary conditions.

Mr. J. B. S. Norton presented some notes on the flora of the southwestern United States. Maps were shown indicating the parts of this region and others not well represented in herbaria, as compared with other sections of the country. Among other interesting features of the Southwest was mentioned the production of many different forms or closely related species in the isolated mountains surrounded by deserts. This was compared with insular conditions and illustrated by the mountain forms of Euphorbia. Specimens of some new species from southwest Missouri were also shown.

Two persons were elected active members of the Academy.

WILLIAM TRELEASE,
*Recording Secretary.*

## NEW YORK ACADEMY OF SCIENCES.
### SECTION OF BIOLOGY.

AT the regular meeting of May 14, 1900, Professor F. S. Lee, presiding, the following papers were presented:

'Some Chemical Notes on the Composition of the Cocoanut,' by J. E. Kirkwood and Wm. J. Gies.

The authors have carried on qualitative work on the ungerminated nut, preparatory to a study of the digestive processes during germination. The chief constituents are cellulose and fat. Some soluble carbohydrate is present, beside globulin and proteose, but no albumen or pepton. Only amylolytic ferments have so far been found. The milk of the nut is normally acid, probably due to acid phosphate. It contains an earthy phosphate, reduces Fehling's solution, sours on standing, and acquires much the odor and physical appearance of soured cow's milk. It shows only small quantities of proteid and fat.

The meat of the average nut contains from two to three grains of globulin, which may be obtained in crystalline form. The authors have made three preparations by the usual methods. The nitrogen averages for these were 17.91%, 17.81%, 17.68%. The ash for the same, 0.13%, 0.41%, 1.05%. From the meat of twelve nuts it was possible to separate a little more than three grains of proteose by the usual method. The average of three closely agreeing determinations of nitrogen was 18.57%; of the ash it was 1.71%. The quantitative relationships of these and other constituents will be subjects of combined investigation.

Dr. Curtis drew attention to the irritation of the mucous membrane of the bladder and urethra caused by drinking too freely of cocoanut milk. Dr. Gies, in answer to a question, stated that the food content of the cocoanut is small.

'The significance of Carbohydrates in Muscle,' by Frederic S. Lee and C. C. Harrold.

This work is a continuation of the senior author's study of the nature and causes of muscle fatigue. Of the two supposed causes of fatigue, loss of substance necessary to contraction and poisoning by so-called fatigue products, the present work deals with the former. It is well known that the drug phlorhizin causes the removal of the carbohydrates from an organism to which it is administered. The authors find that it induces decided evidences of fatigue in the muscles of fasting cats. A well phlorhizinized muscle is comparable to a normal muscle in the late stages of fatigue. This effect seems to be due, not to a specific action of the drug on the protoplasm of the muscle cells, but to the loss of carbohydrate from the muscle. This conclusion is rendered probable by the fact that when an animal has been put well under the influence of phlorhizin, the administration of sugar (dextrose) counteracts the effect of the drug, removes the evidences of fatigue and restores the muscle. It seems probable that the loss of carbohydrate is an important factor in the early stages of muscle fatigue.

Incidently some observations on rigor mortis have been made. A muscle well under the influence of phlorhizin may begin to go into rigor five minutes after death and rigor is complete very early. This confirms the conclusions of others that there is a close connection between rigor and carbohydrate. A muscle irrigated with dextrose is capable of giving fully as many contractions as, or even more than, a normal muscle without dextrose.

The election of sectional officers resulted in the appointment of Professor C. L. Bristol, of the New York University, as Chairman, and Professor F. E. Lloyd, of Teachers College, as Secretary for the ensuing year.

F. E. Lloyd,
*Secretary.*

## TORREY BOTANICAL CLUB.

At the meeting of Wednesday, April 25, 1900, the paper of the evening was by Mr. David Griffiths, 'Some Saprophytic Fungi.' Mr. Griffiths described the mechanical devices employed by the genera of the Pyrenomycetes for the distribution of their spores. The genera described with reference to this point were *Podospora*, *Sordaria*, *Deletschia*, and *Sporomia*.

In *Podospora* the ascus elongates to the apex of the perithecium, where it is ruptured and the spores are scattered.

The genus *Sordaria* distributes its spores in the same manner but with a definite point at which the ascus ruptures.

The methods of ejection in the case of the other two genera, are very similar, except in the details of the rupture of the internal membrane of the ascus; here the membrane elongates instead of the ascus itself.

The meeting of Tuesday, May 5, 1900, was held in the lecture hall of the Museum building at the New York Botanical Garden, with a lecture by Dr. M. A. Howe, on 'The Hepaticæ.' The term *Hepaticæ* was used in a restricted sense, excluding the Anthocerotes.

After a few introductory remarks in regard to the position occupied by the *Hepaticæ* in the vegetable kingdom, the speaker reviewed the life-history of a few of the typical forms, the principal details of structure being exhibited by aid of lantern slides. The slides also showed the habit characters of various local species and of some from the Pacific coast.

Though the *Hepaticæ* are on the whole inconspicuous, and attract little attention except from the botanical specialist, they are nevertheless extremely diversified in structure and often very beautiful in form. Their chief interest, however, to the naturalist lies in the fact that many of them throw light upon questions concerning the evolution of the plant world. The first plants, without doubt were purely aquatic in habit of life. The *Hepaticæ*, though favoring moist situations as a class, range from species which are wholly aquatic to those which have become adapted to quite arid conditions.

As a group they may be considered to be the lowest of the chlorophyll-bearing land plants.

J. K. Small,
*Sec'y Pro. Tem.*

## DISCUSSION AND CORRESPONDENCE.

### THE STUDY OF GREEK AND LATIN *vs.* MODERN LANGUAGES.

IN his discussion in SCIENCE of May 25th, of the question: 'Should Greek and Latin be required for the degree of Bachelor of Arts,' Professor Stevenson seems to me to slight some points that bear essentially upon the merits of the question, at least so long as the methods and subjects utilized in teaching the modern languages are not materially changed. As matters now stand, I think it may fairly be claimed that, *as a matter of fact*, the bulk of graduates omitting Latin and Greek from their curriculum, are usually found sensibly deficient in broadness of general culture, when placed alongside of graduates from a 'classical' course. As one who has had special occasion to make the comparison, I should rarely choose, outside of scientific discussion, the social companionship of those educated only in the lines of sciences and modern languages, as now commonly carried out.

That as broad an education *can* be given through the modern languages as through the ancient ones, I fully agree, even though I cannot but think that the more complete grammar of the latter imparts a kind of mental training not easily duplicated by the study of German and French; while the deficiencies of the English language in grammatical forms, however, conducive to its adaptation as a world-language, leaves one who knows *it* alone, peculiarly ignorant of language-structure in general, and hardly capable of a critical understanding of even English literature.

But even admitting that translations of the ancient classics into the chief literary modern languages afford satisfactory access to the writings of the ancient authors through which the civilizations that have so largely shaped our own have been transmitted to us, the fact is that these translations are practically never used in the 'new' education. Wilhelm Tell and Maria Stuart, with a few of the easier prose writings of Goethe, Lessing and others, form the standard works the student sees after he 'absolves' the German readers; in French, Telemaque constitutes, as a rule, the sole book read that has any reference to classic antiquity. It is true that the student *can* subsequently read the translations of the classics; but not one in a hundred does so. The result is that not only bachelors of arts, but even masters of the same, and, sad to say, even some modern doctors of philosophy, are found to be blissfully ignorant of the fact that the Greeks and Romans ever did anything which an enlightened modern scientist is bound to respect. With the bare smattering of history brought from the high school, dimmed by a crowded four-years curriculum, the bachelor too commonly emerges with the impression, if not conviction, that modern time and its brilliant scientific and industrial achievements, is really all that is worth considering. Frequently even the history of his own special science is wholly unfamiliar to him, as may be but too frequently observed in the case of those who have graduated on the basis of 'organic' chemistry, and pride themselves upon their ability to produce new compounds by the score, with the exact structure-formulæ in black-and-white, but who barely remember, in a general way, such names as Lavoisier, Davy, and Berzelius, much less what their science owes to these men.

Certainly such ignorance of the history of man, political, philosophical and scientific, as we already so commonly find in the modern college graduate, is a most serious evil; conducing as it does to a one-sided view of life, and especially to that overweening self-esteem which is not only socially offensive, but vitiates effective scientific work, by the failure to co-ordinate it with that of those who have preceded in similar lines of study. To avoid this narrowness, then, it would be necessary to revise materially the kind and scope of reading done by bachelors of arts in the modern languages.

Freedom of election of studies is a very seductive watchword; but freedom without corresponding intelligence to make beneficial use of it is a delusion and a snare, in education as well as politically—as this nation has abundant reason to know. One of its not altogether happy results is the proverbial American youth, of both sexes, whose precocity and brightness is but too generally associated with a lack of reverence ('veneration,' *phrenologice*) between which, and the extreme repression of youthful

exuberance in the earlier stages of European education, the choice is frequently painful. It is to be hoped that means may be found to establish a happy mean between the two; but it is quite certain that among the subjects of education conducive to that end, the history of the intellectual evolution of mankind must find a more conspicuous place than is assigned to it in the latest scheme of higher education. The titles bachelor and master of arts should, in my view, together with the doctor of philosophy, remain the badge of such broader education; and those who are content with narrow lines should also be content to receive only a corresponding degree. E. W. Hilgard.

University of California.

PHOSPHORESCENCE IN DEEP-SEA ANIMALS.

It is stated, among others, by Beddard in his animal coloration that the brilliant and varied colorations of deep-sea animals are totally devoid of meaning, either by way of protection or warning, for the simple reason that not enough light penetrates to the depths of the sea to permit them to be visible. But in a paper on the 'Utility of Phosphorescence in Deep-Sea Animals,' in a late number of the *American Naturalist*, it is maintained by C. C. Nutting that the quantity of phosphorescent light emitted by the animals of the deep sea is very considerable—so great, in fact, as to supply over definite areas of the sea bottom a sufficient illumination to render visible the colors of the animals themselves. This lighting up of the depths of the sea would be of manifest benefit to the various animals which combine to bring it about—it would serve much the same purposes as protective, aggressive, alluring and directive colorations. For the free-swimming animals—fishes, crustaceæ, molluscs, part of the cœlenterates, most of the protozoa—the utility of phosphorescence is the more readily obvious; but since practically all deep-sea forms live exclusively on animal food, and since it is well known that light exerts a strangely attractive power on widely different forms of animal life, the fixed species would also enjoy at least the benefit of attracting their prey. A very large number of crustaceans are phosphorescent, often brilliantly so; many of them have large eyes and are particularly active in movement and voracious in appetite; they feed on minute organisms for the most part, and it can hardly be doubted that they often use their phosphorescent powers for the purpose of illuminating their surroundings and revealing their prey. Certain cephalopods secured by the *Challenger* have been made out to have a highly specialized apparatus designed to reflect light from their phosphorescent bodies downward to the bottom over which it passes; in this case there is not only light but also a reflector, an efficient bull's eye lantern for use in hunting through the abyssal darkness.

Among the ctenophores and medusæ we encounter amazing displays of the 'living light'; as these animals have eye-spots, and seem to be able to distinguish light, their phosphorescence may serve to keep them together in groups and thus effect the same end as directive coloration among vertebrates and insects. It is important to note that blind species of groups normally possessed of eyes are seldom if ever phosphorescent. Noctilucca and other allied Protozoa are often found at considerable depths, and hence come under the head of deep-sea forms, but they differ from the organisms already mentioned in having no recognized organs of sight, and also in an extreme simplicity of organization. They, however, occur in enormous swarms and hence must have some means of keeping together, and moreover, they have been proved to be, although eyeless, extremely sensitive to light. In fact, it is practically certain that sensitiveness to light is a fundamental property of simple protoplasm. It is easy to conceive, therefore, that in these little creatures their phosphorescence is directive in function; the same thing is doubtless the case with a medusa of the subtropical Atlantic, which thickly covers hundreds of square miles of surface, and which glows like a living coal at night. C. L. Franklin.

Baltimore, Md.

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## *CURRENT NOTES ON METEOROLOGY.*

### BALLOON METEOROLOGY.

The rapid development of what may well be called balloon meteorology has resulted in the

publication of a large number of articles on this subject within the last four or five years. Indeed, the number of publications has been so large that it has been difficult even for the student of meteorology to keep up with the literature. We now have an octavo pamphlet of 161 pages, entitled *Beiträge zur Erforschung der Atmosphäre mittels des Luftballons* (Berlin, Mayer und Müller, 1900. Price, 4 Marks), which will serve well as an introduction to the study of the most recent work done in balloon meteorology. This report is edited by Dr. Assmann, and has chapters by Berson, Gross, Kremser and Süring—all of them men who have been closely associated with scientific ballooning in Europe. Dr. Assmann contributes an introduction and a chapter on the equipment needed on a scientific balloon voyage. The others have prepared chapters on the various ascents between March 1, 1893, and February 15, 1895. An appendix contains tables showing the most noteworthy data in connection with the ascents from February 15, 1895, to the end of 1899. This book is a striking illustration of the rapidity with which the investigation of the upper air by means of balloons has progressed. Record is given of 77 ascents.

### ERRORS IN SCHOOL BOOKS.

IN a recent number of the *Monthly Weather Review*, Professor Abbe calls attention to the fact that the geography adopted by the Legislature of Montana for use in the public schools of that State contains the following remarkable statement: "The warm winds known as the chinook winds, from the Pacific, heated by the Japan current, may spring up even in the coldest weather." This view as to the source of warmth of the chinook winds is entirely erroneous, just as is a similar view formerly commonly held in regard to the warmth of the Swiss *foehn*, viz, that that wind, coming down warm and dry in the northern Alpine valleys, has its origin in the desert of Sahara. The warmth and dryness of chinook and foehn are the result of the warming by compression of the descending air, as was very fully explained by Hann, in the case of the *foehn*, some years ago. It is a serious thing to have children in the public schools of one of our States taught any doctrine so erroneous as that which refers the warmth of the chinook to the Kuro Siwo.

### THE CLIMATE OF NEW YORK STATE.

A RECENT number of the *Bulletin of the American Geographical Society* (No. 2, 1900) contains an article on the climate of New York, by E. T. Turner, which gives an excellent presentation of the chief climatic features of the State. The article is largely a reprint of a report upon the same subject by Mr. Turner, originally published in the *Fifth Annual Report of the Meteorological Bureau and Weather Service of the State of New York* (Albany, 1894, pp. 347–457). Several new charts have, however, been added, including some typical barograph and thermograph curves, and two thunderstorm charts. It would be well if similar condensed reports upon local climates were available for our other States.

### LOSS OF LIFE BY LIGHTNING IN 1899.

ACCORDING to A. J. Henry (*Monthly Weather Review*, March, 1900) the loss of human life by lightning in the United States during the year 1899 was greater than in any preceding year for which statistics have been collected. The number of persons killed outright, or who suffered injuries resulting in death, was 562, and the number of those who received injuries varying in severity from slight physical shock to painful burns and temporary paralysis of some part of the body was 820. The greatest number of fatalities (45 per cent.) occurred in the open; the next greatest number (34 per cent.) occurred in houses; 11 per cent. occurred under trees, and 9 per cent. in barns. At least a dozen persons were killed either in the act of stripping clothes from a wire clothes-line, or by coming in proximity thereto during a thunder storm.

### RECENT PUBLICATIONS.

*Studies of Cyclonic and Anticyclonic Phenomena with Kites*, by H. H. Clayton. Second Memoir. Blue Hill Meteorological Observatory, Bulletin No. 1. 1900. 4to. Pp. 36. Pls. IV. This is Mr. Clayton's second Bulletin on the theory of cyclones and anticyclones as viewed in the light of the Blue Hill kite records. The author holds that a modified convectional theory,

rather than the Hann, or driven, theory, best explains the facts discovered.

*Anales de la Oficina Meteorologica Argentina*, por su Director, Gualterio G. Davis. Tomo XII. *Climas de Asuncion del Paraguay y Rosario de Santa Fe.* Segunda Parte: *Discusion de las Observaciones hechas en Asuncion y Rosario.* 4to. Buenos Aires. 1898. Pp. 297. This is one of the valuable series of publications on the climate of the Argentine Republic which is being issued by Mr. Walter G. Davis, the Chief of the Argentine Meteorological Service.

R. DeC. Ward.

Harvard University.

## *CURRENT NOTES ON PHYSIOGRAPHY.*

### PHYSIOGRAPHY OF MARYLAND.

'A General Report on the Physiography of Maryland,' a dissertation by Cleveland Abbe, Jr., for the degree of doctor of philosophy at Johns Hopkins University (Maryland State Weather Service, i, 1899, 41–216), stands with the account of Missouri by Marbut, of New Jersey by Salisbury, and of New York by Tarr as one of the few thorough studies of State geography that have yet appeared in this country. Many items of interest might be abstracted from it. For example, those concerning the lower courses of the 'falls' or young cascading streams in the narrow gorges by which the Piedmont plateau is dissected for eight or ten miles inland from the fall-line, and the upper courses of the same streams which flow quietly through shallow open upland valleys where the effects of the elevation of the region are not yet felt. Again, those concerning the Hagerstown (Appalachian) valley, a well-finished and evenly uplifted peneplain, now rather sharply dissected by young streams in narrow meandering gorges, from which it is inferred that the streams meandered upon the valley floor before uplift of the region to its present altitude (500 feet in the neighborhood of the Potomac). A chapter on the development of the streams of the Piedmont plateau bears evidence of the greatest proportion of original study; it leads to the conclusion that the streams east of Parr's ridge (which represents a low swell surmounting the former lowland of the Schooley peneplain) have been superposed through a cover of coastal plain strata that once extended further inland than now.

An introductory account of 'Physiographic Processes' contains a paragraph which may mislead by stating that the ridges of the Appalachian province have been 'formed by the folding and faulting of the paleozoic strata of that district.' A learner might thus be tempted to compare them with the young unsculptured mountain blocks of southern Oregon; yet, as indeed appears from other pages of the Report, the Appalachian ridges of to-day are as truly forms of circumdenudation as are the low hills of the coastal plain or the high hills of the Allegheny plateau.

### THORODDSEN ON ICELAND.

Thoroddsen has prepared a most interesting summary of his eighteen years of exploration in Iceland (*Geogr. Journ.*, xiii, 1899, 251–274, 480–513). The island, 40,450 square miles in area, is the dissected remnant of a basaltic plateau, averaging 2000 feet in altitude, and for the most part barren and uninhabitable. Non-marine tertiary strata are intercalated within the basalt sheets, and a 'pelagonite breccia'* overlies them on a third of the surface. Deep valleys and fiords have been eroded in the margin of the plateau, where coast cliffs rise 2000 or 3000 feet; but in the interior the relief is less pronounced. Relatively modern lavas have been poured out abundantly on the plateau, building mountains, filling valleys, displacing rivers and altering the coast line. Of 107 volcanoes counted in a certain district, 8 were large lava and ash cones of the Vesuvian type, 16 were large flat domes of the Mauna Loa type, and the remainder were small ash cones arranged in chains along fissures. The summits of the domes, 2000 or 3000 feet in height over the plateau, are broken by large craters (calderas?) containing frozen lava lakes; many lava tunnels are found on the slopes of the domes, whose inclination is seldom more than 7° or 8°, and may be much less. The small ash cones may be as steep as 30° and occasionally 40° or even 50°: one chain contains

* This formation has lately been interpreted as of ancient glacial origin by H. Pjetersson. *Scot. Geogr. Mag.*, xvi, 1900, 265–293.

100 such cones along a 20 mile fissure. At some points, the lava has flowed quietly from fissures without forming cones or craters. Lava sheets and streams, sometimes scores of miles in length, are as barren as the domes of ice and snow. The more viscous flows have steep borders, so that they rise in ragged ridges, impassable from being covered with loose clinkery fragments. The more fluid flows have formed smooth and nearly level fields, except that their surface is here and there disturbed by irregular subsidence, or broken by great cracks which turn back the traveler. Secondary craters are numerous on certain flows, sometimes to the number of hundreds crowded together, as if the flow had run over a marsh or lake. Parts of the plateau are covered with drifting sand, swept about in blinding storms. The whole island has been deeply covered by an ice sheet (except where an occasional volcanic cone rose as a 'nunatuk' or island), as is proved by abundant striations, morainic deposits and transported boulders, save over some 5000 square miles where the glaciated surface has been buried under the more recent lavas. Lakes of glacial origin are numerous. Sheets of ice and snow to-day cover about an eighth of the island area, mostly as mantles over the domes of the plateau from which a few glacial arms descend to lower levels.

The lowlands are of small extent. They consist of narrow coastal plains (strips of sea bottom revealed by recent elevation) or of fluviatile plains built forward by waste-laden glacial rivers. Two elevated shore lines on the inner margin of the coastal plains stand at heights of 250 and 125 feet, marked by cliffs, caves and beaches; the strata of these plains contain marine shells. The fluviatile plains or 'sandr' are chiefly developed on the southern coast, where the rainfall is two or three times heavier than in the north. Here one finds all the phenomena of aggrading braided rivers; a single glacial torrent may, on emerging from the highland, split into a hundred shifting channels, with islands of sand and clay occupying the meshes of the network. The rivers are exposed to 'ice-floods' when the glaciers of the highland domes are melted by volcanic heat; overwhelming turbid torrents then bear huge ice fragments and abundant rock waste down to the sea. The southern coast has been rendered harborless by the growth of the 'sandr,' and the shore is frequently bordered by off-shore sand reefs, built by the heavy surf. Elsewhere the coast is extremely irregular, bold headlands projecting between long fiords, into which the streams from the uplands fall in high cascades. Rivers of clear 'mountain water' have not yet formed important delta plains; but where the rivers bring down 'glacial water,' the fiords are shoaled and extensive delta plains occupy their heads.

Settlements are limited to the lowlands, where the people pasture cattle and sheep on the plains, catch birds on the cliffs, and take fish from the sea. But besides suffering the disadvantages of an inclement climate, the lowlands are exposed to lava floods which bury the fields, to river floods which lay them waste, and to ash showers which poison the pastures, causing famine and death to beast and man. It is indeed curious that a people brave enough to discover distant Iceland in a stormy sea, hardy enough to inhabit it for a thousand years, and intelligent enough to develop a remarkable literature, should not have had enterprise enough to leave the island for a more favorable home. Evidently the world is not in the 'free market' that the older economists supposed.

W. M. DAVIS.

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## *SCIENTIFIC NOTES AND NEWS.*

ABERDEEN UNIVERSITY, at its graduation ceremony, conferred the degree of Doctor of Laws on Professor Josiah Royce, of Harvard, who had recently completed the second series of Gifford Lectures before the university.

PROFESSOR D. A. KENT, of the Iowa State Agricultural College has been appointed by the Sultan of Turkey, instructor of farming for the Turkish Empire.

PROFESSOR M. B. BRUMBAUGH, who holds the chair of pedagogy at the University of Pennsylvania, has been offered the office of Superintendent of Instruction at Porto Rico. It is understood that he will accept if he can secure a leave of absence of four years from the University.

PROFESSOR ERNST HAECKEL has been elected an honorary member of the Academy of Sciences at Bucharest.

THE Literary and Philosophical Society of Manchester has elected the following honorary members: Professor James Dewar of the Royal Institution, Professors A. Ewing and A. R. Forsyth of Cambridge University, Professors Ernst Haeckel of Jena, and H. A. Lorentz of Leiden, Mr. Robert Ridgeway of Washington, and Mr. Beauchamp Tower of London.

PROFESSORS JOSEPH LE CONTE and William Carey Jones, of the University of California, have been granted a year's leave of absence from the University which they will spend abroad.

PROFESSOR MACFARLANE, of the State Normal College, Ypsilanti, Mich., has returned from Vienna, where he has been studying geology for the past year with Professor Penck. During the autumn months he will be at Harvard University, carrying forward his studies with Professor Davis.

DR. CHARLES F. CHANDLER, professor of chemistry in Columbia University, president of the Society of Chemical Industry, which meets next month in England, sails for England on June 16th.

PROFESSOR GEORGE F. SEVER, of Columbia University, has accepted the position of superintendent of electrical exhibits of the Pan-American Exposition.

MISS MARY H. KINGSLEY has died at Simonstown, South Africa, where she had been superintending the arrangements of the military hospitals. Miss Kingsley, who was the daughter of Dr. G. H. Kingsley and a niece of Charles Kingsley, made in 1893 and in 1896 journeys through little known parts of Africa and published accounts of her explorations in two interesting volumes 'Travels in West Africa' and 'West African Studies.' She also made valuable botanical collections in St. Paul de Loanda, Old Calabar and the region of the Niger coast protectorate.

MR. G. F. GÖRANSSON who made important improvements in the Bessemer process for making steel has died in Sweden at the age of 81 years.

WE also regret to notice the death at the age of 77 years of Mr. James Thomson of Glasgow, known for his geological work especially on Scottish carboniferous corals.

MR. WILLARD N. CLUTE, editor of the *Fern Bulletin*, has returned from Jamaica with several species of plants that were unknown to science. He will probably return for more specimens. In the eastern part of the island away from the cities he saw but few remains of prehistoric peoples. The present natives often bury their dead in their own front yards, erecting over each grave a rectangular structure of brick and mortar the size of the grave and about two feet high. This is covered with a large flat stone or stones. The negro folk-lore of Jamaica is being recorded by Mr. Edward S. Earle, of Kingston.

PRESIDENT JORDAN and Mr. John O. Snyder, of the Department of Zoology in Stanford University sailed June 6th on the steamer *Gaelic*, for the purpose of making a collection of the fishes and insects of Japan. They will be assisted in Japan by S. Kuwana, an assistant in entomology at Stanford, who sailed to his native country on an earlier steamer, by Keinosuke Otaki, a graduate of Stanford, now teacher in a royal military academy in Tokyo, and by James F. Abbott, also a graduate of Stanford, now teaching in a governmental school at Otsu. The expedition is under the patronage of Mr. Timothy Hopkins, founder of the Hopkins Seaside Laboratory at Monterey. It is hoped that a full survey of the fish fauna of the islands may be made, and generous collections of other forms of life are expected.

G. B. GORDON, who has charge of the explorations to be made at Copan, has secured from President Sierra of Honduras, for Harvard University, by treaty arranged at Tegucigalpa on February 22d, the control of the ruins of Copan and the lands pertaining thereto, for a period of ten years, with the right to make excavations and to remove to Cambridge for preservation a portion of the objects that may be found.

IT is stated in *Nature* that Mr. J. S. Budgett has left Liverpool on his second expedition to the Gambia, where he is going in order to com-

plete his studies of the fish-fauna of that colony, and especially to investigate the life-history and development of the abnormal fishes *Polypterus* and *Protopterus*. On reaching Bathurst, Mr. Budgett will proceed up the River Gambia to his former quarters on M'Carthy's Island, in the neighborhood of which he has already ascertained that these fishes are found breeding during the rainy season. A paper on points in the anatomy of *Polypterus*, based on specimens obtained by Mr. Budgett during his first expedition, was read before the Zoological Society on May 8th, an abstract of which we published recently.

PROFESSOR W. M. DAVIS of Harvard University, Professor R. E. Dodge of Teachers College, Columbia University, and several other geologists are engaged in making an exploratory trip through the Grand Canyon of the Colorado.

THE Royal College of Surgeons of England will, as we have already announced, celebrate its centenary at the end of July. The exercises will begin with a *conversazione* at the College on the evening of Wednesday, July 25th. On Thursday morning Professor Stewart, F.R.S., the conservator, will give a demonstration in the Hunterian Museum. On the afternoon of the same day a general meeting will be held in the theatre of Burlington House, when the President, Sir William MacCormac, will deliver an address, and honorary fellowships will be conferred. In the evening a festival dinner will be held in the great hall of Lincoln's Inn. On Friday morning Professor Stewart will again give demonstrations, and on the evening of that day a *conversazione* will be given by the Lord Mayor at the Mansion House.

A DESPATCH to the daily papers states that an explosion occurred in the mechanical laboratory at the Agricultural College, at Lansing, Mich., on June 5th, while Professor M. D. Atkins was conducting an experiment in the presence of the students. Professor Atkins was seriously burned, and the sight of his left eye was destroyed by flying particles of glass. H. D. Hornbeck, a student, who was assisting, was also badly burned, and it is feared he will lose his right eye.

M. CREVAT-DURAND, of Fontainbleau, has by his will made generous public bequests, including 150,000 frs. to the Paris Pasteur Institute. The addition to the Institute, which comprises a hospital and laboratories for biological chemistry, is now complete.

THE difference between the Senate and the House of Representatives in regard to an appropriation for the Hydrographic Bureau of the Navy Department, which created special interest and prevented the adjournment of Congress at the expected time was compromised by giving $50,000 to the Bureau for Ocean Surveys, but providing that the survey should not be extended to the coasts or inland waters.

M. MASPERO, the new *directeur des antiquités et des fouilles en Egypte*, in a paper before the *Académié des Inscriptions et Belles-lettres*, explains a long hieroglyphic inscription containing fourteen engraved columns. This granite stele was found at Kem-gayet on one of the estates of Husseinpacha, uncle of the Khedive, and was presented immediately to the Gizeh Museum. It represents the king Nectanebo II., the last pharao of the native dynasties and bears the date of the reign. Nectanebo is making an offering to the goddess Nel de Saïs in gratitude for benefits received at her hands.

DR. THEODORE BEER, whose valuable studies on the sensory organs of both vertebrates and invertebrates are well known, is engaged in writing a comprehensive work on the *Comparative Anatomy and Physiology of the Organs of Vision*, and to make this as complete as possible he is anxious to acquire separates of all articles —for which, if desired, he will send his own writings in exchange—dealing in any way whatever with the anatomy, embryology, zoology, pathology, or literature of the organ of sight in animals or the eye of man, or with reactions to light. Dr. Beer is particularly desirous that none of the widely scattered writings of Americans should escape his attention, and therefore especially invites the co-operation of all Americans who can aid him. Communications should be addressed: Dr. Theodore Beer, *Privatdocent für vergl., Physiologie a. d. Universität*, Anastasius Grün-Gasse 62, Wien, XVIII, Austria.

*UNIVERSITY AND EDUCATIONAL NEWS.*

COLUMBIA UNIVERSITY has received an anonymous gift of $100,000 for a building to be devoted to the religious life of Columbia, like Dwight Hall, at Yale, and Brooks House, at Harvard.

MR. J. B. DUKE, of Durham, N. C., has presented Trinity College, of that city, with $50,000 for a library.

IT is said that President Taylor will be able to announce at the Vassar commencement, that the $25,000 needed for a biological laboratory in addition to the $25,000 given anonymously, has been secured, and that the building will be erected without delay.

BY the death of Mrs. Juliet S. Bradford, half the estate of Dr. Vincent L. Bradford of Philadelphia, who died sixteen years ago, reverts to Washington and Lee University. The University will receive $100,000 and the testator's law library and paintings. The amount is still charged with several annuities, and by the terms of the will the paintings and the law library are to be kept up by the annual appropriation of $500 and $400 respectively.

IT is planned by a corporation composed chiefly of friends of Teachers College, Columbia University, to purchase a site and erect a dormitory for the College on the Amsterdam avenue front of the College block. The approximate cost is estimated at $1,000,000.

A NEW chair of physics, the Wykeham professorship, has been established at Oxford, and steps are being taken to establish a special laboratory in connection with it.

THE wood-working shop and men's gymnasium of the University of Illinois were destroyed by fire on June 9th.

A FRESHMAN at Harvard University has been sentenced to five days in jail by Judge Almy for stealing a sign, which appears to be a sensible way to put a stop to such minor breaches of the law among college students.

PROFESSOR F. P. VENABLE, Ph.D., F.C.S., director of the chemical laboratory in the University of North Carolina, was on June 5th unanimously elected to the presidency of that institution. He succeeds Dr. E. A. Aldemann, who, as we have already reported, goes to Tulane University as president.

NATHAN R. LEONARD, who for twenty-seven years has been professor of mathematics in the State University of Iowa, has been elected president of the Montana School of Mines, at Butte.

AT the University of Pennsylvania Dr. J. William White Rhea Barton has been appointed professor of surgery, and Dr. Edward Martin and Dr. Charles S. Frazier clinical professors of surgery. Dr. Richard M. Pierce was made demonstrator of pathology, and Dr. William F. Hendrickson and Dr. Frederick H. Howard assistant demonstrators in pathology.

DR. F. L. DUNLOP leaves the Worcester Polytechnic Institute to accept an instructorship in Chemistry at the University of Michigan.

PROFESSOR ROBERT B. OWENS, of McGill University, has been appointed to the Tyndall fellowship in physics of Columbia University, and Mr. J. A. Matthews has been appointed Barnard fellow.

AT the University of North Carolina, J. E. Mills, A.B., A.M. (Davidson College N. C.), has been made assistant in chemistry, and J. E. Latta, Ph.B. (University of N. C.), instructor in physics.

DR. MAX MEYER, formerly assistant in the psychological laboratory at Berlin and this year honorary fellow in psychology in Clark University, has been appointed professor of psychology in the University of Missouri. Dr. Charles W. Green has been appointed instructor in zoology in the same University.

MR. J. FRANK MESSENGER, B.A. (Kansas, 1895), has been appointed assistant in the psychological laboratory of Harvard University.

WE notice the following appointments in German Universities: Dr. Alfred Wohl docent in chemistry at the University of Berlin, has been promoted to a professorship; Dr. A. Fritsch of Vienna, has been appointed associate professor of botany in the University at Gratz; Professor Eugen Meyer of Göttingen, has been made professor of mechanics in the Institute of Technology at Charlottenberg, and Dr. Schmeisser of Klausthal, director of the Geological Institute of the School of Mines at Berlin.

# SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; JOSEPH Le CONTE, Geology; W. M. DAVIS, Physiography; HENRY F. OSBORN, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; C. E. BESSEY, N. L. BRITTON, Botany; C. S. MINOT, Embryology, Histology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; WILLIAM H. WELCH, Pathology; J. McKEEN CATTELL, Psychology; J. W. POWELL, Anthropology.

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## *THE NEW YORK MEETING OF THE AMERICAN ASSOCIATION.*

THE annual meeting of the American Association for the Advancement of Science is the chief scientific event of the year, and the meeting about to open in New York promises to be one of the most important in the history of the Association. This is guaranteed by the fact that some fifteen special scientific societies, a considerably larger number than ever before, meet with the Association, and it is definitely proved by the programs issued in advance by most of the sections and by some of the independent societies. These show that the most active men of science from all parts of the country will be present to report upon the results of their most recent researches and to take part in the discussions. It is certainly not only the duty, but also the privilege of those interested in science to use all possible efforts to be present at the meeting.

Those familiar with the history of modern science will realize the difficulties that must be met by an association seeking the advancement and diffusion of science as a whole. The question was comparatively simple when the Association was organized in 1848. Then and until 1875 the members could meet in one body and in the earlier period at least each could have an intelligent understanding of all the work presented. During this period too there was a general popular interest in science.

The applications of the principles of physics and chemistry to the living body, and the development of the doctrine of evolution awakened a lively interest, as they seemed to many to controvert not only generally accepted doctrines but even religion itself. But as heat was converted into light, as science found its due place in education and in modern life and settled down to the steady routine of laboratory and field, as each science became technical and required for economy and accuracy a special terminology, not only was there a decrease in popular interest, but the workers in one department could not be expected to be familiar with science as a whole.

The American Association has naturally reflected the progress of science. At the meetings held at Buffalo and Burlington at the close of the civil war there was an attendance of only about seventy-five members. Then the Association steadily grew until the meetings at Boston (1880), Montreal (1882) and Philadelphia (1884) were attended by about one thousand members. A stationary condition or perhaps a decline then occurred, which seems to be explained by increasing specialization and decreasing popular interest. These conditions are now being met by an adjustment to the altered environment. In 1875 separate sections were organized for the physical sciences and for natural history, and in 1882 nine sections were established, but it was not until 1893 that botany was separated from zoology. In the meanwhile separate societies have been organized for nearly all the sciences, meeting the needs of modern specialization. Some of these societies, not finding a proper place in the Association, have joined in a Christmas session, but others have chosen the time and place of the meeting of the American Association. At first it was feared that these special societies would injure the parent Association, but it was found that the simultaneous meeting of the American Chemical Society made the section for that science the strongest in the Association. The many special societies meeting this year in New York will probably bring together more men of science and contribute more to the advancement of science than any scientific gathering ever held in America. At the same time the membership of the Association will be larger than it has ever been before.

With the approval of the Council, the local committee for the New York meeting has confined its attention to arranging for the scientific work of the sections. There is much to be said for leaving the general arrangements for the meetings in the hands of a central administration and the cost to the Association, and for abolishing free luncheons, free excursions, etc. Missionaries may be fed on charity, but business men prefer to pay their own bills. The Association can no longer hope to carry science to the houses of the people, at least not in a city such as New York, but meets to promote its own interests and the interests of its members. The fact that these interests are identical with the interests of society is certainly a reason for satisfaction and pride and should lead to the conduct of the meeting with added dignity.

The fact that the Association will be welcomed to New York by the local members rather than by the citizens of the city and that the excursions will be scientific rather than sight-seeing in character will probably not detract from the social intercourse which is one of the important functions of such meetings. Men of science wish to see and hear each other rather than on-lookers and outsiders, and they are competent to decide what they wish to see in a city such as New York. The headquarters at the Hotel Majestic overlooking Central Park, is within convenient reach of Columbia University and the American Museum of Natural History, where the

sessions will be held. There are in the neighborhood of the University numerous good boarding houses, now empty owing to the absence of students during vacation. The situation of the University with pleasant grounds overlooking the Hudson river, promises reasonable freedom from heat and dust, and ample accommodation both for social intercourse and scientific work.

The Association will be welcomed to Columbia University by President Low, long a member, at eleven o'clock on the morning of Monday, June 25th, and after brief addresses by the retiring president, Mr. G. K. Gilbert and the president-elect Professor R. S. Woodward, the members will separate for the organization of the Sections. On Monday afternoon five of the vice-presidents, Professor Asaph Hall, Jr., Professor Ernest Merritt, Professor Jas. Lewis Howe, Professor J. F. Kemp and Professor William Trelease, will give their addresses, the others being postponed until next year. President Gilbert will give his address at the American Museum of Natural History on the evening of June 26th. Various scientific excursions have been arranged by the different sections, which will be part of their scientific work. A meeting in New York City under the conditions described and at the end of June is certainly an experiment worth making, and there is every reason to believe that it will be successful.

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*PROGRESS OF THE NEW YORK ZOOLOGICAL PARK.*

AMONG the attractive features of the coming meeting of the American Association in New York are the proposed visits to the Botanical Garden and the Zoological Park. These sister institutions are developing rapidly in the northern and southern portions of Bronx Park and both deserve careful study, even in their present unfinished condition. Members of the Association desiring to see both parks on the same day will do well to take a Harlem train direct to Bedford Park, walk through the Botanical Garden and buildings eastward to the Bronx river, then southward along the line of the river to the Boston road entrance of the Zoological Park to the northwestern entrance, returning to New York by the Fordham station of the Harlem railroad. Members desiring especially to see the Zoological Park should take the train from 42d street or 125th street to Fordham.

The following extracts from the Fourth Annual report recently issued by the Zoological Society will give some idea of the present state of development of this project. The Zoological Park was formally opened to the public on November 8, 1899; Professor Osborn delivered the address of welcome on behalf of the Society and the Park was formally accepted by Comptroller Coler. During the inclement months of November and December it was visited by 90,000 people; the present attendance on holidays and Sundays averages between 15,000 and 17,000; the attendance since January 1st is 294,000. The Park is thus a thoroughly popular institution. The membership has risen to over 850 and is slowly increasing; a vigorous attempt is being made to raise the membership to 3000, and thus provide an income which will constantly renew the supply of animals and enable the Society to erect a building every other year.

Up to the present time $10,000 has been expended in the purchase of animals and about $200,000 in the construction of buildings and other installations. The following ranges and installations are now complete:

Mule Deer Range, Fallow Deer Range and House, Axis Deer Range and House, Ducks' Aviary, Flying Cage, Aquatic Birds' House, Black-tail Deer Range, Virginia Deer Range, Red Deer Range and House, Moose Range and House, Wapiti Range and House, Wolf Dens, Fox Dens, Aquatic

Mammals' Pond, Otter Pool, Antelope Range and House, Prairie Dogs' Enclosure, Burrowing Rodents, Small Mammal House (temporary), Wild Turkeys' Enclosure, Reptile House, Crocodile Pool, Bear Dens, Beaver Pond, Buffalo Range and House.

The Aquatic Bird House is very attractive with a large interior flying cage and an aquarium for diving birds. Adjoining the building is the Ducks' Aviary and the large Flying Cage, which it is hoped to complete before the visit of the Association. The Reptile House is the first of the larger type of buildings to be completed and it is a model of its kind, with an extensive display of tropical and North American reptiles. The fine Crocodile Pool and other well planned installations present a great variety and departure from stereotyped methods of exhibition.

The city has thus far expended $125,000 upon the improvement of the grounds, and recently an additional appropriation of $300,000 has been approved by the Legislature but has not thus far passed the Board of Estimate. With this fund it will be possible to render the Park one-third complete. Upon the whole, the city authorities have been very friendly towards this enterprise. The only difficulty has been the inadequate maintenance; only $40,000 has been set aside for the year 1900, whereas the Park cannot be maintained for less than $60,000 in its present state of development, and $100,000 when it is completed. As the Park derives practically nothing from gate receipts and all revenue from privileges is devoted to the purchase of animals, it is entirely dependent upon the city for maintenance, while the Society agrees constantly to supply the animals and to proceed with the erection of buildings as fast as possible.

During the past year under the able direction of Mr. Hornaday the administration of the Park has been thoroughly systematized and the service is very economical and effective. Three Assistant Curatorships have been established as follows:

J. Alden Loring, Mammals; C. W. Beebe, Birds; R. L. Ditmars, Reptiles. The Assistant Curators are energetic in their various branches and it is the intention of the Society, sooner or later, to promote them to curatorships with an increase of salary.

Great care has been exercised in the selection of animals. With the exception of a very few specimens all the animals in the Park were caught wild when young and these types are especially fine examples of their kind. The Buffalo range is supplied with 10 splendid bulls and cows from Kansas. Most of the ranges are also well supplied. On June 1st the Mammal collections of the Park were made up as follows:

| | Species. | Specimens. |
|---|---|---|
| Primates | 6 | 10 |
| Carnivora | 21 | 43 |
| Ungulata | 9 | 28 |
| Rodentia | 6 | 65 |
| Edentata | 1 | 1 |
| Marsupialia | 1 | 4 |
| | 44 | 151 |

On the same date the Reptilian collection consisted of the following:

| | Species. | Specimens. |
|---|---|---|
| Crocodilia | 1 | 18 |
| Chelonia | 22 | 85 |
| Lacertilia | 12 | 65 |
| Ophidia, venomous | 11 | 51 |
| Ophidia, non-venomous | 33 | 186 |
| Amphibia | 13 | 40 |
| | 92 | 445 |

The Bird installations are as yet far from complete; 44 species are represented by 185 specimens.

Chief attention has naturally been devoted chiefly to the raising of funds, to the work of construction and of planning the various installations, the establishment of the many new features which will characterize the future development of the Park. The endeavor throughout has been to do

everything in the best possible manner, carefully studying the best models in this country and Europe and attempting to advance upon anything that has been done hitherto. Thus the Park, although far from complete, in many respects marks a great step forward in zoological park development. Most of the animals enjoy an exceptional amount of freedom. The ranges in the smaller installations are numerous and as a rule the animals are in a splendid state of health. There have been relatively few losses. The rate of growth of the animals especially in the Reptile House and the Bear Dens and in the interior Flying Cage for Birds is rapid and there is every reason to believe that most of these animals are in a perfectly normal state.

Naturally the more purely scientific work in the Society must be deferred. The field of publication has hardly been entered upon. The admirable 'Guide' which was prepared by the Director is proving very popular and has met with large sales. Illustrated bulletins describing the development of the Park have appeared only at rare intervals but it is hoped to make them more regular next winter. Considerable progress has already been made in photography and many of the photographs of living animals are not only beautiful but possess considerable scientific value as presenting perfect representations of pure types of North American and exotic animals, seen to best advantage in their natural surroundings.

HENRY F. OSBORN.

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*SIGMA XI, AT THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.*

DURING the last meeting of the American Association for the Advancement of Science, at Columbus, Ohio, the convention of Sigma Xi was held with a very large attendance, and it was decided to have a reunion of such members of the Society as might attend the meetings of the American Association at New York. It is planned, therefore, to hold a meeting at which all members of Sigma Xi are cordially invited to be present some evening during the meeting of the Association in New York. The date and hour of the meeting will be announced by posters and in the daily program.

The rapid rise of this Society in American universities is signified by the large number of young men prominent among the officers and participants in the various sections of the American Association. It was started in 1886, at Cornell University, by a few graduate students in engineering. At first the intention was to make it a purely engineering society, but soon after its organization the scope of the Society was broadened, so as to take in all the most promising men in the Senior classes giving special attention to any of the branches of science. In its extension to other institutions, it has become the representative honor-society for the ablest students of science in the institutions where it is established.

According to the constitution the object of the Society is to 'encourage original investigation in science, pure and applied.' In the report of the Committee on Extension, made at the convention of 1895, the following words express the purpose of the Society: "In establishing a new chapter * * * in each case we should make sure that we entrust the power of distributing the honor of membership only to such persons and institutions as are capable of giving the education and training necessary to the carrying on of scientific investigation; * * * we should also be well assured of the hearty co-operation of the scientific faculty in the establishment of the local chapter."

At present there are ten chapters connected with the following institutions, and the eleventh has already been voted, although not yet established:

1. Rensselaer Polytechnic, Troy, N. Y.
2. Union College, Schenectady, N. Y.
3. Cornell University, Ithaca, N. Y.
4. Kansas University, Lawrence, Kas.
5. Yale University, New Haven, Conn.
6. Nebraska University, Lincoln, Nebr.
7. Minnesota University, Minneapolis, Minn.
8. Ohio, State University of, Columbus, Ohio.
9. Pennsylvania, University of, Philadelphia, Pa.
10. Brown University, Providence, R. I.
11. Iowa, University of, Iowa City, Iowa.

In the Universities where the chapters have been established, the organization takes the place of Phi Beta Kappa among the science men, and the purpose of the organization is to recognize and associate the men of marked ability in scientific studies. The Society has been running long enough to show very clearly that there is an academic side to science, as well as to literature, and that the academic qualities promoted by scientific studies are as important as those fostered by the pure study of literature. It will be interesting to note in the course of the year to what extent the culture of the scientific qualifications of men gives them power of leadership among their fellows. It is certain that in business affairs we are already observing the important place which scientific ability takes in the really dominant men in America. If the conceptions of Sigma Xi are correct, we shall see a similar condition of leadership among the scientific scholars of the country when sufficient numbers of such scholars have been developed to overcome the precedence which we are accustomed to grant to literature as the standard of real scholarship. The chapters recently started in the University of Pennsylvania and in Brown University exhibit the enthusiasm which is already being kindled in this department of university life. The charter membership in both of these cases was composed, practically, of the whole staff of scientific professors of the university. As an honor society, it promises to take a leading part in all our universities in which science holds a prominent place.

The present officers of the Society are: *President*, H. S. Williams, Yale; *Vice-President*, S. W. Williston, Kansas; *Corresponding Secretary*, J. McMahon, Cornell; *Recording Secretary*, F. C. Caldwell, Ohio; *Treasurer*, E. W. Davis, Nebraska; *Chairman of Council*, E. L. Nichols, Cornell.

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## *THE BIOLOGICAL SCIENCES AND THE PEOPLE.**

Like the American Association for the Advancement of Science (and other similar organizations), the Michigan Academy is an expression of the voluntary scientific activity of the people of the State, and depends for its continued usefulness on a rational interest and a helpful co-operation on the part of the people.

It has therefore occurred to me to inquire in what way the biological sciences, from whose adherents the Academy draws most of its membership, touch the people: what in the growth of these sciences makes toward and what away from a contributory interest on the part of the people. By contributory interest is meant that which aids in the upbuilding of the sciences by adding something of importance to their store of fact or theory. The question that is raised is then, not what benefit do the people receive from the biological sciences, for these are many in the practical and in the educational application of these sciences; the question is rather how may or how do the people benefit these sciences by aiding in their further growth.

I shall speak from the zoological standpoint, but what is true of zoology, is true, in this matter, in large measure, also of botany.

The question seems to be intimately associated with the recent history of zoology.

* Abstract of the address of the retiring president of the Michigan Academy of Sciences, delivered at the Lansing meeting, March 29, 1900.

The year 1859 found zoologists, the world over, working industriously and quietly at almost purely descriptive work. No more was expected of any zoologist than that he should discover and record the wonders of nature as revealed in the animal kingdom, and that he should duly express his astonishment at the infinite wisdom shown by the creator in arranging all these details. Of attempts to get at the meaning of the details there were very few. The popular notion of the zoologist's aim in life is expressed in a question that I remember to have heard asked in my student days, by a much respected professor of literature of his zoological colleague. "Well now what is that animal curious for?" In this year appeared Darwin's 'Origin of Species.' Its effect is thus graphically described by V. Graff in a recent lecture. "It came like a lightning flash in a period of quiet descriptive work, a period which had accustomed itself to consider the nature-philosophy ideas of the beginning of the century as absurd freaks of imagination, unproved and unprovable, a period which therefore clung anxiously to its foundation of facts. How the theory of natural selection put life into this dry describing, how it hurried the knife of the anatomist, and what a broad prospect it opened before the hitherto short sighted eye of the systematist! About the mummies of the species which, separated from one another by carefully formulated Latin diagnoses, filled the collections, there suddenly appeared the constricting noose of blood relationship. The petrified remains of extinct forms, hitherto shut out from the community of living beings, received flesh and blood and demanded to be included with the existing fauna and flora in a single great genealogical tree, representing the history of life on our earth."

Darwin's book brought essentially two contributions. In the first place it brought a mass of *evidence* in proof of the proposition that animals are related to one another by descent. The *idea* of a process of evolution is very old and Osborn has recently traced its history from the early Greeks to the time of Darwin. Darwin did not originate the idea, he established it by a mass of evidence and it has been ever since accepted.

In the second place Darwin contributed the theory of the origin of species by natural selection. This theory is so well known that it need not be restated here, but it may perhaps be pointed out that the theory does not attempt to account for the origin of the variations upon which it depends. It is a fact that these variations occur and Darwin's theory bases itself upon this fact. He spoke of such variations as fortuitous. Aside from certain correlations, variations seemed to Darwin to occur by chance, though he did not exclude the possibility of their being later found to be subject to law.

The idea that the multitude of animal forms had thus originated by a process of evolution, and that this process was governed by a simple law, affected the whole subsequent course of zoology.

Zoologists soon came to accept not only evolution as a process, but natural selection as at least the chief explanation of the process. The zoologists following Darwin made but little attempt to study the variations upon which the theory of natural selection based itself, or to determine the range of variations or their causes. Having decided that animals were related to one another, and having fixed the law governing the origin of the relationship, zoologists began to turn their attention to a study of the degree of relationship. A mania seems to have become prevalent for the construction of a genealogical tree of the entire animal kingdom. The ultimate aim of zoologists ten years ago, or even five years ago was animal genealogy, and such is still the aim of many working zoologists. Paleontology, comparative anatomy and embryology were

believed to furnish the means for unraveling animal genealogies.

All three of these lines of research have been pursued (from the phylogenetic standpoint) with great enthusiasm since 1859, and they are still being pursued; the results have, however, fallen far short of meeting anticipations. From the paleontological side it was evident from the first that many animals had left no recognizable fossil remains. In other cases the remains were so imperfect, so difficult of access and so few that nothing like a complete series could be hoped for. Paleontology has accomplished a great deal. Where it is available, it is without doubt the safest guide, perhaps the only safe guide in phylogenetic speculation. On the other hand it has not, and in the nature of its materials cannot lead to a realization of the zoologists' dream of a phylogenetic millenium.

Comparative anatomy has been to a considerable extent neglected during the past thirty years. Among the invertebrates, where the research could be carried on by the rapid methods of modern microscopic technique there has been more work, than among the larger vertebrates where it is necessary to use the tedious method of dissection. Among the anatomical research of the last quarter of a century there is a noticeable dearth of *monographic* work. In the earlier part of the century anatomists were not so much concerned with the discovery of relationships, they were content to work long on single animals, and there were thus produced anatomical monographs which have not since been surpassed in quality. With the advent of Darwinism came a feverish haste to detect relationships, and this resulted in a desire to compare large numbers of animals with one another. The time required to study the whole structure of a large series of animals was too great for the life time of one man. Much could, however, be accomplished by the comparison of a single organ through a large series of animals—and so the comparative anatomy of animals (monographic work) gave place to the comparative anatomy of organs.

A second characteristic of the comparative anatomy of this period has been its great reliance upon embryology. Its facts have been too often distorted to make them fit with the results of embryological work, and thus what should be the base of the pyramid has been made its apex.

Embryology was, however, the guiding star of the post-Darwinian workers. It seemed to offer by far the easiest and quickest solutions of their problems. It soon developed a technique of great intricacy and of great accuracy, and it came to offer easy conquests to the ambitious investigator. Its faintest hints at relationship were accepted as of the utmost importance and were given the deepest meaning. Scarcely any zoological work was complete without its embryological side. But it soon became evident that the development of an animal could not be construed as a simple repetition of its ancestral history. The ancestoral features were always more or less modified by features impressed upon the developing animal by its surroundings. The embryo was, so to speak, burdened by a double task. It not only repeated the history of its ancestor, but it had also to adapt itself to its own very different conditions. The development thus came to be considered as made up of two factors—those that were ancestral (phylogenetic) and those that were acquired by the embryo and peculiar to it (cænogenetic factors). The record was thus said to be falsified and to pick out the true from the false became the difficult task of the embryologist. This was a task requiring great judgment and one concerning which individual observers were likely to differ greatly. If an observer started out with a certain theory as to the ancestral

history of an animal, all those factors in its development which did not accord with the theory, were apt to seem to him to be falsifications of the record. Another observer with the same facts before him, but working on a different theory, would discover that many of these so-called falsifications were really ancestral features.

Another factor which has hampered embryology as a phylogenetic discipline has been the too frequent limitation of the investigation to a single organ. It is easier to investigate a single organ through a series of embryos than to investigate the entire structure of all the members of the series. We are able to judge correctly of the character of a man only when we know all the elements that make it up. And so with a series of embryos, we must know the whole structure, not merely a part of it. Monographic work is here quite as necessary as in comparative anatomy.

Many illustrations might be given of the grotesque results reached in animal genealogy, principally through too great reliance on embryology. That investigators with the same facts before them may reach diametrically opposite conclusions is shown in the attempt to trace the ancestry of the vertebrates. No less than a dozen invertebrate groups have been announced from time to time as having furnished the vertebrate ancestor. The cœlenterates, the annelids, the nemertines, the crustacea, the spiders, Balanoglossus and the tunicates have all been candidates for this honor, and perhaps all deserve it equally.

With such results the zoological pendulum may be said to have reached, for the present, the limit of its excursion in the direction of phylogeny. It is now beginning to swing in another direction. Within the last five years, zoologists have begun to see that phylogenetic speculations have been to a large extent fruitless of specific results. They cannot be undertaken to advantage until we have vastly widened our field of knowledge. Then too it is being realized that the construction of a phylogeny of animals is, after all, not a matter of the greatest consequence. So long as we know that animals are related to one another and so long as we are able to investigate the laws which have governed the establishment of that relationship, it does not so much matter just *what* the precise relationship may be.

Zoologists are then turning in other directions. There seem to me to be chiefly four.

1. There is among those engaged in purely descriptive anatomy or embryology a tendency, not yet very pronounced, but yet growing, to return to the monographic method of working. This is a return to the methods of the beginning of the century and betokens a purpose to let speculation rest for a while, until more materials have accumulated upon which to base it.

2. There is a marked tendency to study *variations*. The first book on this subject has appeared within a few years, and has stimulated the production of many papers. The purpose of the workers in this field is to determine the nature and range of variation so as to gain a familiarity with the nature of the materials upon which natural selection acts. It may thus be possible, as Bateson points out, for the investigator of the future to say not 'if such and such a variation should occur,' but 'since such and such a variation does occur.' Students of variation hope also to discover some of the laws which determine the production of variations. It is believed that they are not, as Darwin thought, fortuitous, matters of chance, but that they are subject to well defined laws.

All phylogenetic speculation is based upon the idea of homology, but the study of variations has set our ideas of homology toppling and until these ideas are reconstructed we cannot hope for any final determination of animal relationships.

3. Toward a study of the effect of environment in inducing and modifying developmental processes. Experimental morphology, experimental zoology, experimental embryology, are new subdivisions of our subject which express this tendency. It is possible to subject developing animals to the influence of various factors of the environment in order to determine their effect. Developing eggs may be subjected to different temperatures, or to chemical solutions of different sorts and strengths or to the influence of electricity. In this way we may find what influence each of these factors has on development. Adult animals may be subject to similar changes of environment. The results of such researches are usually expressible by mathematical symbols, such as geometric curves or algebraic equations.

Such work is only in the beginning but it may ultimately lead to such an analysis of the environment as to enable us to assign to each of its factors its proper value as an element in organic development.

Experimental work is also being directed toward a determination of the internal factors of development, those which are resident in the animal itself and are not impressed upon it by the environment. The effect of the removal of portions of the developing egg, enables us to determine the part taken by those portions in the normal development of the whole egg. Others of the internal factors of development may be studied by direct observation (without experiment) and by comparison.

4. Toward a study of the activities of animals. Animals exhibit many sorts of activities that may be classified. Those connected with the taking of food, with reproduction, with the rearing of young, with construction of dwellings, with community life and so on. We are beginning to suspect that many of these activities have features that are common to large numbers of animals and that their origin and development may be traced with as much certainty as the origin and development of the organs of the animals. Many of the activities of man himself may doubtless be traced to an origin in the lower animals and much light thereby thrown on what we are pleased to call *human nature*.

Monographic work in its descriptive branches, the study of variation experimental work, and the study and comparison of the activities of animals seem then to be the directions in which zoological research is now turning.

The phylogenetic phase has passed the height of its development for the present and must await the accumulation of new data before it can again become dominant. But since the study of phylogeny does not really solve any philosophical question (but only gives form to a question already assumed to be solved) it is likely that it will never again become ascendant. Time will bring the solution of many of its problems, but such solutions are likely in the future to possess only a secondary interest.

On the other hand the new lines of work look toward the solution of the most important questions concerning the *method* of origin of organic forms.

Coincident with the gradual acceptance of the evolution idea, and coincident with the great development of morphological and phylogenetic ideas in our universities, there seems to have been a decline in popular activity in natural history. This did not become manifest immediately after 1859, but began, perhaps, ten or fifteen years after that date and has been in progress since then, up very nearly to the present time.

The most striking evidence of this decline is afforded by the decay of natural history societies. In this state Detroit and Grand Rapids each formerly supported such societies. They were well patronized, had

rooms of their own, held stated meetings, and accumulated collections. The Detroit Society has long since decayed and its collections have passed into other hands. The people of Grand Rapids are so apathetic that there seems every reason to fear that they will permit the collections of the Kent County Society, to pass out of the city.

Many similar societies in other parts of the country have had like histories. A number of such are known to me.

This decline of popular interest has affected not so much the theories of natural history as its materials, not so much perhaps popular interest as popular participation. It has taken place by the side of an unprecedented activity in zoology in the universities and colleges and in the scientific work of the government.

May we not seek the explanation of it in two directions. First in the hostility or apathy of the church. So long as the study of natural history seemed merely to reveal the wonders of creation and to magnify the marvellous work of the creator, the church encouraged it. The evolution idea on the other hand was strongly combatted by the church. While it is, perhaps, not possible to trace the effect of this controversy on the popular interest in natural history, we may feel sure that a state of mind which looked upon every animal adaptation, as upon every visitation of disease, as an expression of divine wisdom, must have been more sympathetic toward the study of natural history, than one which saw in the animal only a vaguely comprehended end-result of an evolution process, itself subversive of accepted religious beliefs.

A further reason for the decline in popular interest may be sought in the lack of stimulus from above. The zoologists of the universities and colleges had become morphologists. A few of them kept up an interest in systematic zoology, but for the most part they were engaged in the laboratory study of the anatomy and development of preserved animals. Existing animals, the *end-results of an evolution process* were to be grouped in accordance with their genealogical history. The activities of animals, their habits, habitats, distribution, their relations to their environment, their ecology in short—all these were thought to be of little consequence. Students sent out from the laboratories of these teachers were much more familiar with sections and dissections than with living, or even entire animals. Once removed from the laboratory with its equipment of apparatus such students were quite helpless.

They experienced in most cases great difficulty in finding again in the field the animals that had served their laboratory studies. These students are the persons from among whom the membership in natural history societies is recruited. They are the persons who stimulate, in any community, an interest in natural history studies. These young recruits were then without interest in the study of living animals in their natural environment, while the people were, as they will likely always be, without interest in the laboratory study of anatomy and development. That which interests the people is not the dead end-product, but the living, active animal, the activities of animals, what they do and why they do it.

The people at large care but little about the structure even of man; they will know only what is necessary to care for the machine, and most of that they leave to the doctors. To know the origin of the various structures of man does not greatly interest them. How overwhelming on the other hand is their interest in man's *activities*. No other human interest transcends it.

But just as the structure of man has had a history: just as we may trace the development of his heart or brain through

various stages which exist in the lower animals, so have the activities of man also had a history. The germs of his doings are to be found, perhaps all of them, among the lower animals. The social instinct, the home-building instinct, the instinct to care for the young, and how many others do we find in the lower animals. That these activities of the lower animals have given rise to those of man there seems little room to doubt. Just as the structure of man must be viewed against a background formed of the structures of lower animals, in order that it may be understood, so must man's activities be viewed against the background formed of the activities of lower animals.

Zoologists are only slowly coming to realize this fact, and in the study of variation and its causes, in the study of the relation between the animal and its environment, in the study of ecology, or experimental zoology, we see evidence of this realization.

In this movement, indeed, the popular interest and the popular wisdom find their justification. In so far as zoology affords an explanation of the origin of human activities, it becomes important in the conduct of life, in so far it justifies itself in the eyes of the people. Zoology is now passing rapidly out of the ultra morphological and ultra systematic phase, into a phase where it will concern itself more with the activities of living animals and with the relation of these to the environment.

In these matters it will again appeal to the popular interest. Students from our colleges and universities when they have quitted the laboratory will no longer feel themselves strangers to nature. When they go among the people they will stimulate the study of a rational natural history.

From this cause and from the final lapse of the now nearly extinct opposition of the church we may expect a popular revival of interest in natural history subjects. Indeed, the introduction of nature study into our schools, the increasing number of popular books and magazine articles on natural history indicate that this revival is already at hand.

In the days before Darwin natural history societies contributed no inconsiderable part to the advancement of the sciences of zoology and botany. This they did through their collections and through the discovery by their members of new species, new localities and hitherto unknown habits of animals. May not the revival of popular interest which seems to be at hand again contribute to the advance of zoology? Observations on the daily life of animals, on their distribution and variations, on related subjects, may be made without the elaborate equipment of laboratory and library that is necessary for morphological work. Such observations are well possible to isolated members of a society like this one, and carefully made and well thought out, become real contributions to our science.

Jacob Reighard.
University of Michigan.

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## *THE STEAM-TURBINE.*

An apparently important, and to the writer, at least, new, fact in the operation of the steam-turbine is revealed by experimental investigations in progress for some time past in the laboratories of Sibley College, with both saturated and superheated steam. Contrary to the usual theory of that apparatus, it is found that a very substantial gain may be had by the use of superheat, not only in efficiency but also in *capacity*.

The steam-turbine is not subject to that form of waste known as 'initial' or 'cylinder' condensation which adheres to every piston-engine as a consequence of the large fluctuations of temperature which accompany the variations within the cylinder be-

tween boiler and condenser pressures, and which, with the best of engines employing saturated steam, amount to ten or twenty per cent. and to a multiple of such figures for small machines. The interior surfaces of the turbine, in steady working, remain at precisely the same temperatures and absolutely without those fluctuations which produce waste in the reciprocating, and in the other forms of rotary, engine. As it is to reduce this particular waste that superheating is employed, ordinarily, there would not be expected to be found any other gain by its use in the steam-turbine than that increase of thermodynamic efficiency which is due to the widened range of temperature, in this case amounting to about one-tenth of one per cent. per degree of superheat. Investigations by Messrs. Schieren and Thomas, above alluded to, show, on the contrary, a gain of about one per cent. for each one and two-thirds degrees, C., three Fahrenheit degrees, of superheat and the remarkable and unexpected result of an increase in the capacity of the machine of about one hundred per cent. by the use of but 20° C., 37° Fahr., superheat. The 'water-rate' of the turbine, a La Val machine of ten horse-power as rated, decreased from about 21.7 kgs., 48 lbs., to 1.99 kgs., 44 lbs, with pressure rising from three atmospheres to eight, with a two-thirds vacuum, and with saturated steam; while the figures fell off about 12 per cent. with superheating, rising to a very moderate maximum as above. Reduced to thermal units per horse-power per hour, the same effect appears in a very similar proportion. The causes of the gain in thermodynamic efficiency and of capacity are presumably identical—the extinction of the friction-wastes due to the retardation of the current of fluid traversing the passages of the turbine by concurrent resistances coming of the weighting of the current of steam with drops and mist and the adherence of moisture in mist, drops and even streams, very probably, to the walls of the steam-passages of the turbine. The phenomenon will however, be the subject of extended investigation in the course of the work in research constantly in progress and a way will probably be found of precisely identifying the cause and determining the laws governing its action in the production of these variations of efficiency and capacity. That this apparently obvious explanation is the correct one and, certainly, that the gain is not due any such action as produces the remarkably beneficial effects observed in the reciprocating engine, is tolerably well indicated by the fact that the gain in this case, by superheating, is substantially proportional, so far as here carried, to the amount of superheat and the graphic log shows a straight line of decreasing consumption of steam.

R. H. THURSTON.

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## *THE MORINGUOID EELS IN AMERICAN WATERS.*

NOTWITHSTANDING the numerous eels which have been discovered in American waters, none has yet been found which has been referred to the family of *Moringuidæ*. Indeed, from the literature it would appear that the group was peculiar to the seas of India and the Molucca-Indian archipelago. However, Dr. Smith recently received from Mr. George M. Gray, of Woods Hole, an eel found in branching coral at San Geronimo, near San Juan, on the north shore of the island of Porto Rico, which he was at a loss to allocate and took it to Dr. Gill. The latter was struck by its resemblance to *Aphthalmichthys*, and the subsequent comparison with the figures of Bleeker's 'Atlas Ichthyologiques des Indes Orientales Néêrlandaises' revealed no differential characters to separate it from that genus. Further, a consideration of the very elongated whip-like forms referred by Jordan and Evermann

to the subfamily *Stilbiscinæ* of the family *Muræenesocidæ* shows that all are true *Moringuidæ*, the genus *Stilbiscus* being identical with *Moringua*, having the same structure of the fins. Instead of American waters being destitute of representatives of the family, it now turns out that they are the headquarters of the group and that four genera are found therein—*Moringua*, *Aphthalmichthys*, *Leptoconger* and *Gordiichthys*.

The Porto Rican *Apthalmichthys* agrees most closely with the *A. abbreviatus* of the Indo-Moluccan archipelago (Java, Celebes, Amboyna, etc.). It has a more elongated body (the depth about 54 times in the length), and the head forms one-thirteenth of the length. No true pectorals are developed, although a slight fold exists behind the upper portion of the branchial aperture. The tail forms a little more than one-third of the length. The color in life was a uniform gray olive. The specimen is 270 mm. long. The species may be called *Aphthalmichthys caribbeus*. A detailed description will be published hereafter.

This discovery is of unusual interest. It takes a family out of the category of geographically restricted types and adds one to those of tropicopolitan distribution. It is probable that species will be found under analogous conditions in all tropical seas and that they are rare only in museums. But they are of such a shape and occur amidst such environments that they can only be secured by some happy accident, unless they may be deliberately sought for with proper appliances. The family itself has special interest for the morphologist. The species differ from all others in the great extent of the abdominal cavity (about two-thirds of the total length) and the situation of the heart, which is far behind the gill arches and not close to the hindmost one as in fishes generally.

Theo. Gill.
H. M. Smith.

## *A PRELIMINARY ACCOUNT OF THE SOLAR ECLIPSE OF MAY 28, 1900, AS OBSERVED BY THE SMITHSONIAN EXPEDITION.*

Partly in deference to the report of the United States Weather Bureau, from which it appeared that the chance of a fair eastern sky on the morning of the eclipse was about 8 to 1, and after examination by Mr. Abbot of many stations in North Carolina, Wadesboro, of that State, was selected early in April as the site of the Smithsonian observations. The advantages of Wadesboro being also recognized by Professor Young, of Princeton, Professor Hale, of Yerkes Observatory, and the Reverend J. M. Bacon, of the British Astronomical Association, it came about that four large observing parties, besides several smaller ones and numerous excursionists from the surrounding country, were all joined to produce at Wadesboro one of the largest company of eclipse observers ever assembled for scientific purposes. It is a matter for congratulation that the sky at Wadesboro upon the day of the eclipse was cloudless and clearer than the average, so that the efforts of the observing forces were not thwarted by any circumstances beyond their control. The provisions of the Mayor and authorities of Wadesboro for preventing intrusion before and during the eclipse, and thus securing an undisturbed field of operations, deserve especial recognition. Further than this, the many acts of courtesy and hospitality to the visiting astronomers on the part of the townspeople, will long be remembered by the recipients.

The Smithsonian party proper consisted of thirteen observers, and included Mr. Langley, Mr. Abbot, Aid Acting in Charge of the Smithsonian Astrophysical Observatory, Mr. Smillie, in charge of photography, Mr. Putnam, of the United States Coast Survey, Mr. Fowle, Mr. Mendenhall, Mr. Child, Mr. Draper, Mr. Gill, Mr. Kramer and Mr. Smith. Included with these the

Reverend Father Searle and the Reverend Father Woodman gave most valuable assistance. Mr. Hoxie, of Port Royal, South Carolina, and Mr. Little, of Wadesboro, rendered valued assistance to Mr. Putnam during totality.

Professor Hale, of the Yerkes Observatory, was a member of the party, while still in general charge of the Yerkes expedition, and his counsel and aid were of the greatest service. Mr. Clayton, of Blue Hill Meteorological Station, occupied a part of the grounds of the Smithsonian party.

The main object of the investigation was of course the corona, and of this (first) a photographic and visual study of its structure, with (second) a determination by the bolometer whether appreciable heat reaches us from it, and, if possible, an examination of the form of its spectrum energy curve.

The writer had been particularly struck, when observing the eclipse of 1878, on Pike's Peak, by the remarkable definiteness of filamentary structure close to the sun's limb, and had never found in any photographs, not even in the excellent ones of Campbell taken at the Indian eclipse of 1898, anything approaching what he saw in the few seconds which he was able to devote to visual observations at the height of 14,000 feet. His wish to examine this inner coronal region with a more powerful photographic telescope than any heretofore used upon it, was gratified by the most valued loan, by Professor E. C. Pickering, of the new 12-inch achromatic lens of 135 feet focus just obtained for the Harvard College Observatory. This lens, furnishing a focal image of more than 15-in. diameter, was mounted so as to give a horizontal beam from a coelostat clock-driven mirror by Brashear, of 18-inch aperture, and used with 30-inch square plates. To supplement this great instrument, a 5-inch lens of 38-ft. focus, loaned by Professor Young, was pointed directly at the sun. This formed images upon 11x14 plates moved in the focus of the lens by a water clock. Specially equatorially mounted lenses of 6-, 4- and 3-inch aperture, driven by clock work, were provided for the study of the outer corona, and the search for possible intra-mercurial planets.

For the bolometric work the massive siderostat, with its 17-inch mirror, with a large part of the delicate adjuncts employed at the Smithsonian Institution in recent years, to investigate the sun's spectrum, was transported to Wadesboro. The excessively sensitive galvanometer reached camp without injury even to its suspending fiber, a thread of quartz crystal $\frac{1}{15000}$ inch in diameter.

Besides these two chief aims (the photography and bolometry of the inner corona), several other pieces of work were undertaken, including the automatic reproduction of the 'flash spectrum' by means of an objective prism with the 135-ft. lens; the photographic study of the outer coronal region, including provision for recognizing possible intra-mercurial planets, already alluded to, visual and photographic observations of times of contact, and sketches of the corona both from telescopic and naked eye observations.

The assignment of the observers was as follows: Mr. Langley, in general charge of the expedition, observed with the same 5-inch telescope used by him on Pike's Peak in 1878, which was most kindly lent for this special comparison by Professor Brown of the U. S. Naval Observatory; C. G. Abbot, aid acting in immediate charge, assigned with C. E. Mendenhall to the bolometer; T. W. Smillie, having general direction of the photographic work, made exposures at the 135-ft. telescope; F. E. Fowle, Jr., assigned to 38-ft. telescope; Father Searle, directing the assembled telescopes for the outer coronal region, and for intra-mercurial planets, assisted by P. A.

Draper and C. W. B. Smith, exposed two cameras of 3-inch aperture and 11-ft. focus, and two of 4½-inch aperture and 3½-ft. focus; all four of these telescopes being mounted on a single polar axis driven by an excellent clock; DeLancey Gill assisting Mr. Smillie, removed the flash spectrum objective prism at second contact, and made a single long exposure with a 6-inch photographic lens of 7½-ft. focus equatorially mounted; Assistant G. R. Putman, who by the kindness of the Superintendent of the U. S. Coast Survey, was detailed for latitude,* longitude,† and time observations, also observed contacts, directed the striking of signals by Mr. Little, and rendered other valuable services. Mr. Putman was assisted in recording contacts by Mr. Hoxie. R. C. Child, observing with a 6-inch telescope of 7½-ft. focus, made sketches with special references to inner coronal detail, and was in addition charged with all electrical circuits for chronograph and automatic photographic apparatus. Father Woodman, with 3½-inch telescope, observed contacts and made sketches.

The first detachment, consisting of Messrs. Abbot, Fowle, Kramer (instrument maker) and Smith (carpenter), reached Wadesboro May 4th, and were soon joined by Messrs. Draper and Putnam. The latter returned to Washington after a short but satisfactory latitude and longitude campaign, reaching Wadesboro again just before the eclipse. Other members of the party reached camp on and after the middle of the month. The first comers found a very satisfactory shed already erected and piers begun. Not a day passed from the time of the arrival of the apparatus, May 7th, to the day before the eclipse, that was not fully occupied in perfecting the arrangements.

The most striking portion of the installation was the line beginning at the northwest pier, with its equatorial and cœlostat, continued from thence south of east by the two great diverging tubes of the 135-ft. telescope and spectroscope. These tubes were covered with white canvas, presenting the appearance of two immensely prolonged 'A' tents, ending beyond the photographic house, where the 38-ft. telescope tube pointed east and upward at an angle of 42° with the horizon. When the equatorial, with its large special conical tube camera, with all this long branching extent of white canvas ending in the uplifted tube of the 38-ft. telescope, was seen in the light of the moon, the extensive field with its preparations exhibited a still more picturesque scene than by day.

Less imposing, and perhaps more ungainly, was the combination of four great cameras under the main shed, designed to search for new planets and to depict the outer corona. These might well be described as like a cabin and an outbuilding, mounted on a polar axis, yet despite their awkward proportions they were made to follow very accurately.

The morning of the eclipse dawned cloudless and very fairly clear. Deep blue sky, such as the writer had seen on Pike's Peak, of course is not among the ordinary possibilities of an eclipse, but the milkiness of the blue was less pronounced than is usual in the summer season, and all felt that the seeing promised well.

At fifteen minutes before totality a series of rapid strokes on the bell called everyone to his post, and one minute before the expected contact five strokes were given as a final warning. Coincidentally with the actual observation of the second contact by Mr. Putnam, the first of two strokes upon the bell sounded, and the work began. After 82 seconds (the duration of totality from the Nautical Almanac was 92 seconds) three strokes were given as a signal to stop the long photographic exposures. Scarcely

* 34° 57′ 52″ N.

† $5^h\ 20^m\ 17^s.8$ W.

more than five seconds after this the sun's crescent reappeared. The duration of totality as observed by Mr. Putnam was approximately 88 seconds.

To visual observers the sky was notably not a dark one. No second magnitude stars were observed with the naked eye, and most of the on-lookers saw only Mercury conspicuously, though Venus was distinguished at a low altitude, and Capella also tinctly noticeable. No change in direction of the wind was noticed. Shadow bands were seen, but those who attempted to measure their velocity found them too rapid and flickering for any great exactness in this determination. There was tolerable unanimity among independent observers as to their size and distance apart (about 5 inches) though some thought this less, as totality approached.

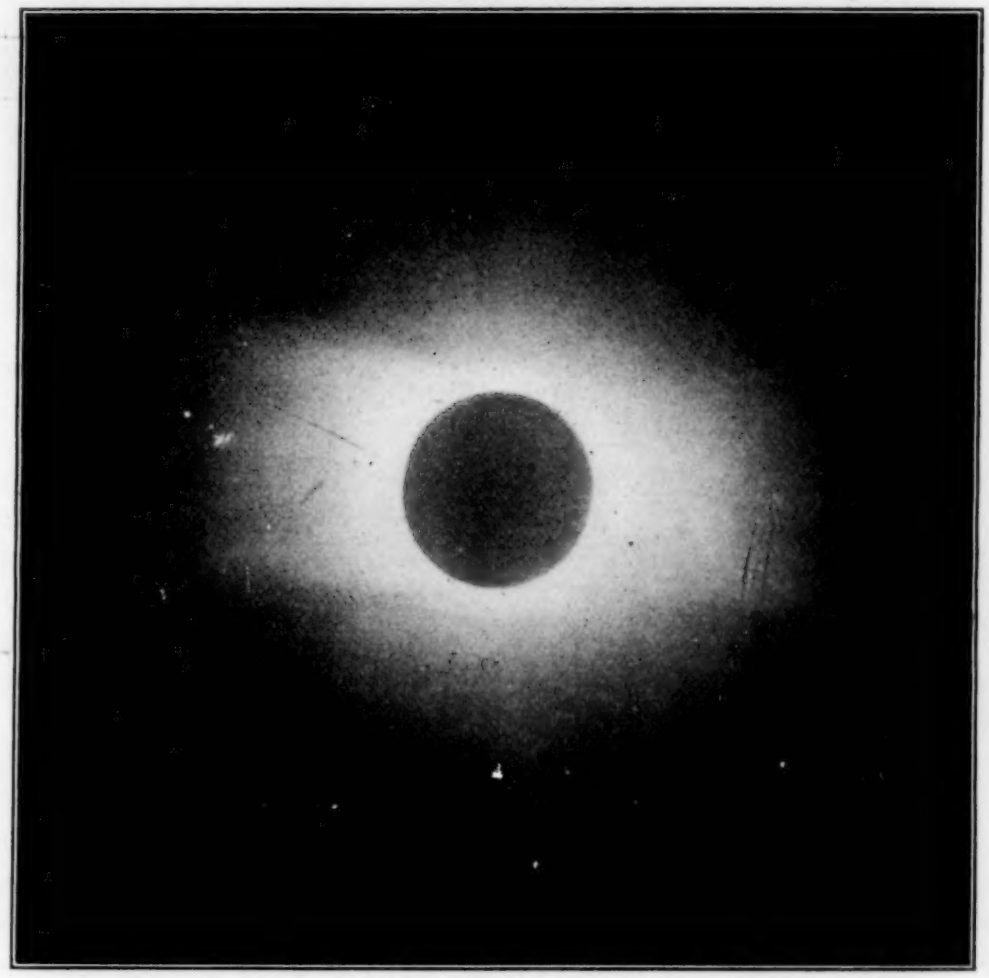

FIG. 1. General view of the corona. Taken with 6-inch lens of 7½ feet focus. 82 seconds exposure.

was seen. So high a degree of sky illumination cannot but have operated unfavorably in the study of the outer corona or in the search for intra-mercurial planets, and this is to be remembered in connection with what follows.

BEFORE TOTALITY.

A deepened color in the sky, a fall of temperature and a rising breeze were dis-

It was noticed that the birds grew silent just before and during totality, but true to their nature, the English sparrows were last to be still and first to begin their discussion of the eclipse, after the return of light.

DURING TOTALITY.

The attention of all visual observers was at once caught by the equatorial streamers.

Father Woodman's comparison of the appearance to a structure of mother of pearl was generally recognized as good, but different observers differed on the color estimate. A yellowish green tinge was noticed by the artist of the party, Mr. Child, while to others the light was straw-colored or golden.

The general coronal form, to the naked eye, was nearly that of the small annexed photograph, which, though taken by one of the smaller objectives, gives a good view of the relative intensities. The same extensions of the equatorial corona could be followed by the naked eye from 3 to $3\frac{1}{2}$ solar diameters.

The visual telescopic observations of the writer gave little indication of the finely divided structure of the inner corona which he had noticed at Pike's Peak. Structure, to be sure, was evident, but not in such minute subdivision as had then been seen, and though one remarkable prominence as well as several smaller ones was visible, the coronal streamers did not give to the writer the impression of being connected with these prominences, though the relationship of some of them to the solar poles was abundantly manifest.

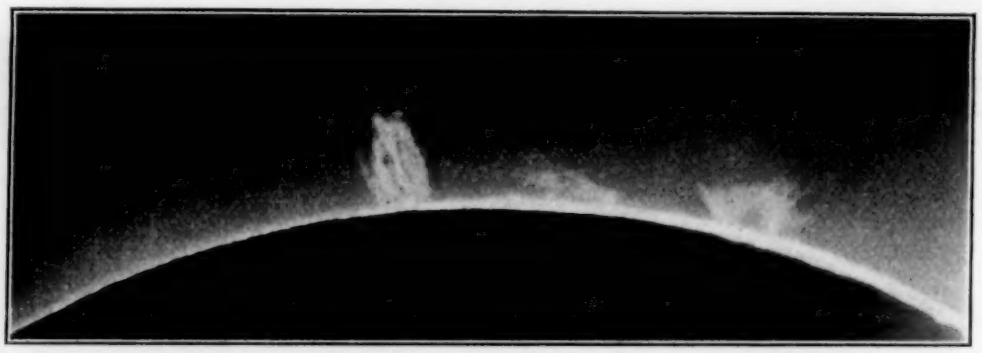

Fig. 2. Prominences on southwest limb of sun. Taken with 12-inch lens of 135 feet focus. Exposure 8 seconds.

### AFTER TOTALITY.—RESULTS.

Comparing notes after totality, all observers reported a successful carrying out of the program. The greatest interest centers in the direct coronal negatives taken with the 135-ft. telescope. Mr. Smillie exposed six 30x30 plates during totality, with times ranging from $\frac{1}{2}$ a second to 16 seconds, and three others were exposed by him immediately after the third contact.

At this writing, only a part of the negatives taken have been developed. Their general quality may be inferred from the examples here given, after due allowance for the great loss suffered by translation on to paper even with the best care.

Figure 1 is a view taken with one of the smaller objectives (6 inches), given here to afford the reader an idea of the general disposition of the coronal light. The upper part is the vertex in the inverted field.

Figure 2 is a portion of one of the great 15-inch circular images obtained with the 135-ft. focus telescope. It was obtained in the great disk in the last exposure during totality of 8 seconds, showing one of the principal prominences then on the sun's disk, with a disposition of the lower filaments near it.

Fig. 3 is a portion of the same set of plates, but taken with a 16 second exposure. The part near the sun has, of course, been intentionally over-exposed, in order to better exhibit the remarkable polar streamers, extending here to a distance of about six minutes from the sun, but still further in Mr. Child's telescopic drawing (not given).

Figure 4 is a view of a small part of the great apparatus on the field, including the terminus of the horizontal tube with its canvas covering, which has been described as like an extended 'A' tent. The photographic room is seen at the end of the tube and beyond that the tube containing the lens loaned by Professor Young, pointing directly skyward.

That it will be impracticable to give here all of the disc of the moon in the large photographs, will be evident when it is considered that the lunar circumference on each plate is about 4 feet; but it will be inferred from the examples that the prominences and polar streamers as well as their features, appear in imposing magnitude and detail.

Many of what it is hoped will be most interesting photographs still await development, but Mr. Smillie's thorough preparation is promising adequate results.

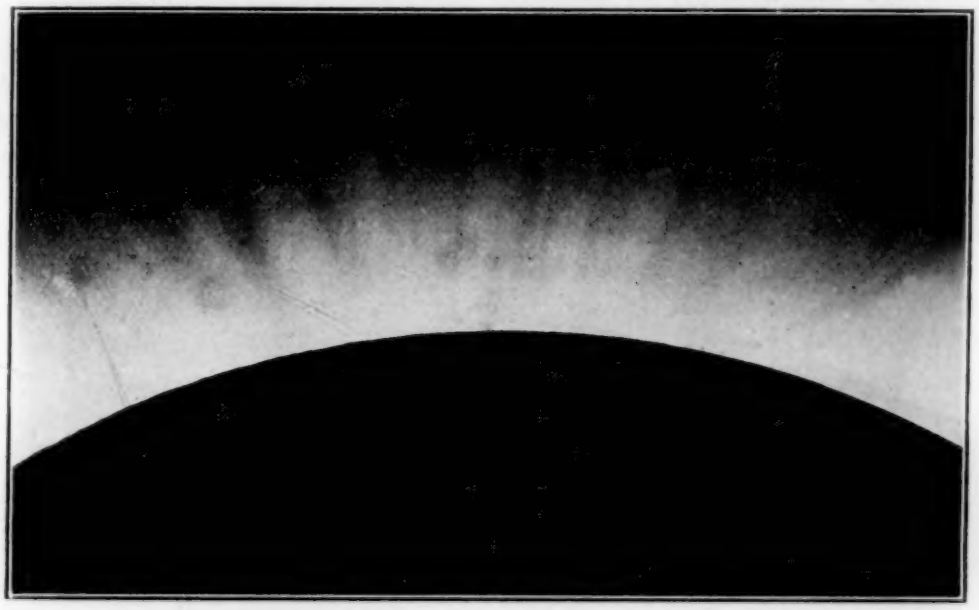

FIG. 3. North polar coronal streamers. Taken with 15-inch lens of 135 feet focus. Exposure 16 seconds.

### HEAT OF CORONA.

Mr. Abbot, with the aid of Mr. Mendenhall, appears to have measured the heat of the corona, and in spite of previous efforts, this is probably the first time that it has been really shown to exist. For five minutes before second contact, the bolometer was successfully exposed to the region of the sky close to the narrowing crescent of the sun where the corona was shortly to appear. A diaphragm was interposed in the beam having an aperture of only 0.4 sq. cm. and deflections rapidly diminishing from 80 to 6 mm. were obtained, the last being about 40 seconds before totality. Then the diaphragm was opened to 290 sq. cm. and a negative deflection of 13 mm. was observed after totality, where these positive deflections had just been found, showing that the corona was actually cooler than the background which had been used at the room temperature. Next the black surface of the moon was allowed to radiate upon the bolometer, and the still larger negative deflection of 18 mm. was observed.

The important result was that the corona gave a positive indication of heat as compared with the moon.

This heat, though certain, was, however, too slight to be subdivided by the dispersion of the prism, with the means at hand.

The negatives taken to depict the outer

corona show from three to four solar diameters extension for the longest streamers. The equatorial 'wings' as they recede from the sun, are finally lost in an illuminated sky, without any indication of having actually come to an end.

No attempt to carefully examine the plates taken for intra-mercurial planets has yet been possible. It is, however, as has been remarked, doubtful if very faint objects will be found, in consideration of the considerable sky illumination during totality. However, Pleione in the Pleiades, (a star of the 6.3 magnitude) is plainly seen on one of the plates and some smaller ones are discernible.

On the whole, the expedition may be considered as promising to be very satisfactory in its results, and that it was so, is largely owing not only to the efficient care of Mr. Abbot, but to the many gentlemen who have assisted me with the loan of valuable apparatus, with counsel, with voluntary service, and with painstaking observation, to one and all of whom I desire to express my obligations.

S. P. Langley.

Smithsonian Institution,
Washington, D. C., June 9, 1900.

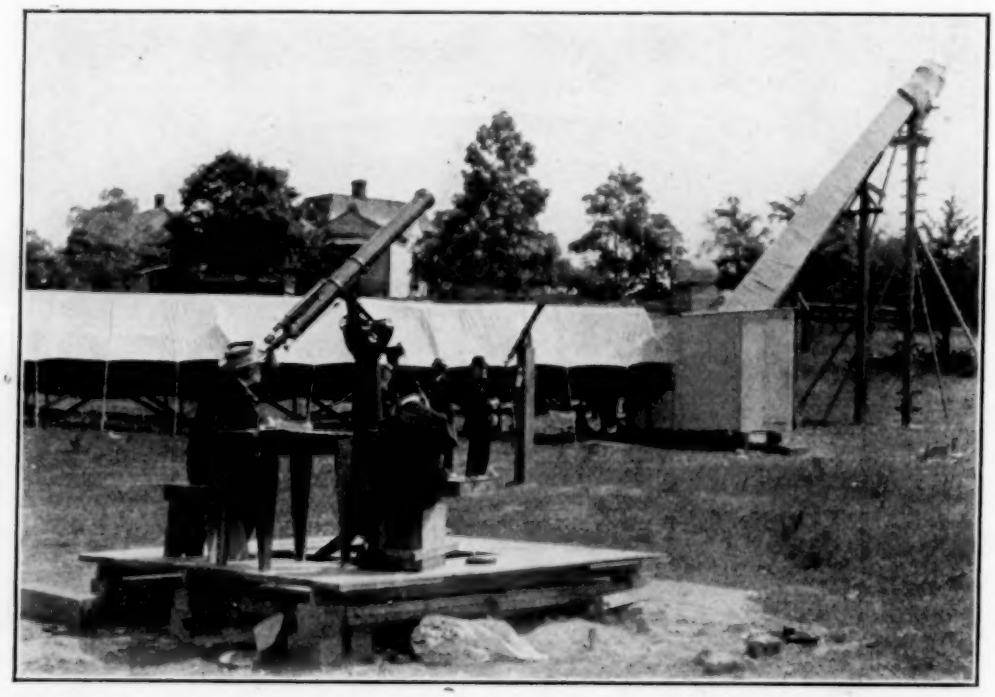

Fig. 4. Dark room and tubes of 135 foot and 38-foot telescopes. 5-inch equatorial in foreground, Professor Langley observing.

## *SCIENTIFIC BOOKS.*

*Text-Book of Paleontology.* By Karl A. von Zittel. Translated and edited by Charles R. Eastman. English edition, revised and enlarged by the Author and Editor, in collaboration with C. E. Beecher, J. M. Clarke, W. H. Dall, G. J. Hinde, A. Hyatt, J. S. Kingsley, H. A. Pilsbry, C. Schuchert, S. H. Scudder, W. P. Sladen, E. O. Ulrich, C. Wachsmuth. London and New York, Macmillan & Co. 1900. Vol. I. 8vo. Pp. x + 706. 1476 woodcuts.

This volume is the result of an interesting experiment. To take an epitome of a science, impressed with the individuality of an eminent investigator, who is if anything even more eminent as a teacher, a clear synopsis drawn up on an harmonious plan, distinguished by both breadth of outlook and a restraining common sense, and then to entrust the several chapters of this work to men who are essentially special-

ists and enthusiasts, many of them without notable experience as teachers, and to permit them to correct, revise, or even rewrite as each thinks fit: the very boldness of the attempt deserves success. But when the original author is representative of the somewhat conservative European school of thought, and his revisers are for the most part leading exponents of revolutionary American ideas, then who can wonder if the result is curious rather than satisfactory? Professor von Zittel would be the last person to claim infallibility, and it is not surprising that the enormous mass of detail condensed into his 'Grundzüge der Palæontologie' should contain some removable errors. Dr. Eastman might with advantage have done one of two things. He might have given us a translation of the 'Grundzüge' with these errors corrected by his corps of specialists; or he might have sketched out the plan of a new work, in which the phylogenetic and morphogenetic principles of Professors Hyatt, Beecher and others should have had free play. But what we have here is neither one thing nor the other. The mistakes of the original are in very many cases still uncorrected, often added to in somewhat inexplicable fashion (as when Wachsmuth alters the correct '*Holocrinus* W. u. Spr.' to the incorrect '*Holocrinus*, Jaekel'); on the other hand, the opinions of the Munich professors, which after all are entitled to some respect, have as often as not been brushed aside, and some new and untried scheme of classification put in their place. The unity of the work, as the author's own preface points out, has been destroyed, and the student is presented on the supposed authority of Zittel with views opposed not merely to those of that eminent paleontologist, but often to one another. The climax is reached when most of the genera referred on pp. 102 et sq., to the Chætetidæ and Fistuliporidæ, families of Anthozoa, are repeated under Bryozoa as Cerioporidæ (p. 266), Fistuliporidæ (p. 269), Monticuliporidæ (p. 272), Heterotrypidæ (p. 373), Calloporidæ (p. 274), and Batostomellidæ (p. 277). We are left wondering what is to become of *Chætetes* (which no doubt is a coral) and *Labechia* (which is probably a Stromatoporoid). In this way the elementary student is fogged, while the more advanced student is uncertain on whose authority doubtful or novel statements are made. And possibly some may think that the advertisement of this book as a 'Text-book of Paleontology by Karl A. von Zittel' is an unwarrantable use of a famous name and an abuse of the professor's well-known kindness.

After this protest it is pleasant to be able to express gratitude for much of the fare with which the enterprise of Dr. Eastman and Messrs. Macmillan has provided us; and more particularly are thanks due to the many specialists who have undertaken a difficult and ungrateful task.

English speaking readers should be glad to have Professor von Zittel's admirable Introduction in more accessible form. The translation is flowing without being much too free; but the statement (on p. 8) that "many fossil crinoids before maturity resemble the living genus *Antedon*" is not the same as "many fossil crinoids may be compared with the young stages of the living genus *Antedon*." To say that the appli cation of the term 'fossil' to any organic remains is determined solely by 'the geological age of the formation in which they occur,' is unnecessarily to exaggerate a restriction which Professor von Zittel has already made too strong. An explorer in a new country finds a cliff containing shells or bones; these eventually prove to be of identical species with animals now living in the neighborhood, and it is inferred that the rock has been formed and elevated within the historic period. The observation is a geological observation, and the argument is precisely the same as it would have been had the organisms proved of Cretaceous age. Why should the remains be called fossils in one case and not in the other? The true criterion seems to be that 'fossils' have been buried by natural causes. Thus one emphasizes that uniformity of geological operations which Professor Zittel's qualification tends to obscure.

The chronological table would have been of more service to those for whom the translation is intended, had the gallicised terms of the last column been replaced, so far as possible, by American equivalents. It is hard to see the point of 'Danian Series (Danien), Senonian Series (Senonien)' and so on.

The chapters on Protozoa and Cœlenterata,

the latter including Sponges, show little alteration, which is just as well. Additional references to writings on Protozoa are given on p. 36, but among them is no mention of C. D. Sherborn's 'Bibliography of the Foraminifera.' On p. 82, Professor von Zittel has himself added a summary of Dr. Ogilvie-Gordon's classification of Anthozoa, but without expressing any opinion as to its value.

The account of the Crinoidea, good as it was in the 'Grundzüge,' has been greatly improved, presumably by Wachsmuth, who also made valuable additions giving the latest views of Wachsmuth and Springer. This should be most useful to those unable to see the splendid monograph by those authors. The same learned writer also revised the accounts of the Cystoidea and Blastoidea. It is the more unfortunate that so authoritative a piece of work should be marred by several slips. Fig. 237, *A*, *a* is not a 'posterior view' of *Pisocrinus*, but is from the right side, as also is *B*, *a*. The stem of *Herpetocrinus* is anything but 'sharply pentagonal' in section (p. 153). *Achradocrinus* appears in two families (pp. 155, 158); the former position, in the Gasterocomidæ, is probably the correct one. The calyx of Apiocrinidæ is not 'unsymmetrical' (p. 167). 'Jaekel regards the centrodorsal (of *Tetracrinus*) as representing the anchylosed basals, notwithstanding the absence of axial canals,' should read: 'because of the presence of axial canals.' Fig. 296, '*Caryocrinus*' should be *Caryocystis*. *Camarocrinus* *Lobolithus* and *Lichenocrinus* are without doubt the roots of Pelmatozoa and not cystid calyces, as on p. 183. The anus of *Anomalocystis* is unknown; the account of it on p. 186 is therefore incorrect. The analysis of a Blastoid theca (Fig. 312) is oriented in a very puzzling manner; the uppermost radial is the right anterior, the lowest deltoid is the left posterior, the lower deltoid on the right is therefore the posterior and ought to show a notch or hole for the anus. These little slips are just the things that worry an earnest student.

Mr. W. P. Sladen has not taken advantage of the opportunities offered by a revision of the Asteroidea and Ophiuroidea, while in the Echinoidea he has not advanced beyond the classification of Duncan in his Linnean Society paper with its pre-Linnean nomenclature. The account of the sea-urchins is, however, clear and comprehensive, and additional references to publications are given. Among these the reference to Keyes, *Proc. Iowa Acad. Sci.*, Vol. II., will not be of much use to students on this side of the water, if I may judge by my own fruitless attemps to see that paper.

A little more exactitude has been introduced by Dr. G. J. Hinde into the chapter on those troublesome fossils assigned to worms of one sort or another. One looks in vain, however, for any pronouncement on the perplexing *Platysolenites* of the Cambrian. Its associate, *Volborthella*, is placed among the Cephalopoda, a position that will need some defending.

The account of the Bryozoa has been expanded from 9 to 34 pages by Mr. E. O. Ulrich, and many illustrations have been added. This careful piece of revision is most welcome.

Recent work on the Brachiopoda is summarized by Mr. C. Schuchert, who has contrived to classify all the genera on the basis given by Beecher. Modification in details will doubtless be required, but Mr. Schuchert works on advanced lines, and his attempt must prove of the greatest service to the many workers who are attempting to apply modern ideas to the vast hordes of fossil brachiopods.

In entrusting the Pelecypoda to Dr. W. H. Dall and the rest of the Mollusca, with exception of the Cephalopodes to Mr. H. A. Pilsbry, Dr. Eastman has been well advised. There are no higher authorities on those groups. Dr. Dall's contribution is an adaptation of his memoir published by the Wagner Free Institute of Philadelphia in 1895. The main divisions, based largely on the characters of the hinge, may commend themselves to those who deal mainly with the fossil shells, while Dr. Dall has evaded the objections that have been raised to some of the minor groupings—Palæoconcha, Schizodonta and the like—by stating that these terms are retained 'merely as convenient descriptive appellations, and are in nowise to be regarded as possessing systematic values.' Though further investigation both of adult morphology and of ontogeny is sure to modify the phylogenetic bases on which the ultimate classification must rest, yet this careful synopsis

will prove of distinct value for reference. Neither Dr. Dall nor Mr. Pilsbry departs so far from accepted ideas that his scheme cannot easily be used by those accustomed to the views of other teachers. In this connection, however, one point may puzzle the inquirer, and that is the attachment of the names of the present writers to family names that were well known almost before those gentlemen were born. What for instance is the meaning of 'Chitonidæ, Pilsbry'; 'Arcidæ, Dall,' or 'Anatinidæ, Dall'? It must be recognized by this time that scarcely any family is regarded by each fresh systematist in the precise sense of the first founder; and if Lamarck, Gray and the rest are quoted in some cases, why not in others? No attempt to attribute authority to family names can attain absolute justice, and the simplest solution is to omit the names of authorities altogether. But if Mr. Pilsbry, for example, claims to have modified the conception of Chitonidæ, it would be well to give the date of the publication in which it was done, so that we may know precisely what value to attach to the collocation 'Chitonidæ, Pilsbry.' Fortunately there do not appear to be any new generic names in these chapters: *Prolucina*, Dall, is unfamiliar certainly, but had it really been new, so careful a worker as Dr. Dall would have indicated the fact.

It is deeply to be regretted that the above commendatory remarks cannot be extended to the section on Tetrabranchiate Cephalopoda. Professor Hyatt has devoted his high abilities to the study of those animals with such enthusiasm and success, that his account was eagerly expected. It is a disappointment. What we are given is little better than a preliminary notice of 'an exhaustive monograph,' which will doubtless have great value when it appears; but the present abstract is of slight use to the beginner and incomprehensible even to the specialist. One can sympathize with a man of peculiar knowledge and original ideas, called upon suddenly to edit an account with which he is in total disagreement; but Professor Hyatt has attempted too much for the allotted space. Dr. Eastman, as editor, should have refused these crowds of new and undefined genera, thus making room for clearer elucidation of the principles on which the new classification was erected. He should also have eliminated the numerous inconsistencies that disfigure the work. They are of many kinds: family names sometimes have an author's name added, sometimes not; a species is often ascribed to two different authors, there are three instances on pp. 588–9; the legends to figures do not always agree with the text; the genders of adjectives do not always agree with their substantives; there is also a confusion, which might easily have been avoided, between the 'siphon (funnel)' and 'siphuncle' of Professor Verrill, and the 'siphonal funnels,' 'siphuncle' and 'siphon' of Professor Hyatt. The retention of Tetrabranchiata as a subclass to include both Nautiloidea and Ammonoidea is perhaps not due to Professor Hyatt; it involves certain statements concerning extinct forms, and especially concerning Ammonoidea, that are absolutely unwarranted by evidence.

It is not clear who is responsible for the changes in the account of the Dibranchiate Cephalopods. But it is clear that the homologies of the cuttle-bone are not yet appreciated. When they are, we shall no longer see *Belemnosis*, *Beloptera* and *Spirula*, in one suborder, and *Belosepia* and *Sepia* in another.

The recasting of the section on Trilobites by Professor Beecher, and that on Merostomata by Dr. J. M. Clarke, the latter incorporating the results of Holm, Laurie and others, will prove most useful. There are also other changes of value under the head Crustacea, due to Professor J. S. Kingsley, Dr. J. M. Clarke and Mr. E. O. Ulrich. But while we would gladly leave the precise classificatory relationships of Trilobita and Merostomata still unsettled, we should like to see the discovery of *Pollicipes* and *Scalpellum* in the Silurian of Gotland recognized by some text-book before another eight years have passed.

The defects in form and arrangement shown by this volume must be a source of regret to all who believe that a good book covering the whole field of systematic zoology cannot nowadays be written without the co-operation of specialists. To attain success, an editor is required honey-tongued enough to get all he wants out of his helpers, strong enough to sub-

ordinate them to the scheme of the book, and with grasp enough to weld their contributions into a consistent whole. With the experience he has now acquired, and with his own relatively greater knowledge of the subject, Dr. Eastman will doubtless do better in Volume II. Meanwhile this first volume forms a wonderful storehouse of facts, drawings and names; and no more reliable compendium of the paleontology of invertebrate animals is to be obtained.

The copy submitted for review bears date 1900, and there is no indication of the fact that pages 1–352 were first published in November, 1896. They were issued in a separate wrapper, with title marked Vol. I., Part I., and dated London and New York, 1896. But as it happens, this Part I. was *not* published in London: the publishers refused, and still refuse, to sell it in England, and I owe my copy to the kindness of Dr. Eastman. Therefore both title pages are bibliographically incorrect—'for trade reasons.' I am also informed that the sections by Dr. Dall and Professor Hyatt were distributed some time ago; but that was no doubt a private matter, which cannot affect the date of the new names.

Trade reasons must also account for the fact that the English editions of so many German scientific works are printed with a smaller page, into which the illustrations do not fit. But it is to be hoped that there is no real need for such works to be printed on porous paper. This is particularly unfortunate in the case of really useful books, such as the present, deserving of permanent correction and annotation.

F. A. Bather.

*The Meyer's Kinetic Theory of Gases.* Oskar Emil Meyer, translated from the second revised edition by Robert E. Baynes. London, New York and Bombay, Longmans, Green & Co. 1899. Pp. xvi + 472.

"I undertook therefore to exhibit the kinetic theory of gases in such a way as to be more easily intelligible to wider circles, and especially to chemists and other natural philosophers to whom mathematics are not congenial. To this end I endeavored, much more than was otherwise usual, not only to develop the theory by calculation, but rather to support it by observation, and found it on experiment."

This extract from the Author's Preface, apparently written in English by the author, will be recognized by all who know his treatise in any form, old or new, as an accurate description of his work. Boltzmann, in the *Vorwort* to his *Gastheorie*, remarks: "Jedoch verfolgt das Meyer'sche Buch, so anerkannt vortrefflich es für Chemiker und Studirende der Physikalischen Chemie ist, völlig andere Zwecke." The contrast between the purpose of Meyer and that of Boltzmann is as marked now as it ever was; for the new edition of Meyer follows very closely the lines of the first. The nut is still cracked for us in the first part of the book and the kernel exposed, while the shell is carefully saved in the mathematical appendices for those who may be disposed to try their teeth upon it.

The clear yet compendious character of the treatise has made it an excellent book to consult; and it has therefore seemed to the reviewer worth while to make a somewhat detailed comparison of the new English edition with the old German one, in order to note the developments which have been made during the past twenty-three years in what may be called the physicist's, as distinguished from the mathematician's, knowledge of gases. The following quotations are accordingly selected to illustrate the most important of these changes. They touch many, but not all, interesting features of the kinetic theory. It will be seen that the time since the first edition of Meyer appeared, in 1887, has been for this theory a period of confirmation and careful improvement rather than one of revolution or rapid advance. The nature and results of intermolecular attraction, the conformation and internal properties of the molecule, these are the problems with which the theory is now engaged, and these are problems with which progress may well be slow.

In the following reviews the title of each successive chapter, up to the mathematical appendices, will be given, even when the chapter contains nothing deserving of special mention as new.

Chapter I.—*Foundations of the Hypothesis.*

Chapter II.—*Pressure of Gases.*

Chapter III.—*Maxwell's Law of the Unequal Distribution of Molecular Speed.*

"Its discoverer, J. Cl. Maxwell, first proved it by the assumption of a principle which, though true, itself needs proof. Since Maxwell himself recognized this defect, he later gave a second proof, the basis of which is subject to no doubt" (p. 45). "L. Boltzmann completed and perfected this proof by employing stricter mathematical work, and thus removing just ground for doubt. A further step forward [1887] we owe to H. A. Lorentz, who raised a new objection and improved the calculation, thereby inciting Boltzmann to again give a new proof [1887], which proof may now be considered as quite free from objection.

"Further, Kirchhoff has given a proof of the law in his Lectures [1894]; but against this, too, according to a remark of Boltzmann, objection may be made.

"In a different way the proof of this law was attempted in the first edition of this book. The weak points of this attempt were removed by N. N. Pirogoff [1885], and a varied form of Pirogoff's proof is given in the second of the Mathematical Appendices [of this book]" (p. 46.)

§ 34, on pressure of a gas in motion, and § 35, on reaction and cross-pressure, contain matter especially referred to in the preface as not in the first edition. They have perhaps nothing more quotable than the last paragraph of § 35, which is notable as including the only mis-translation that I have observed in the English edition. The paragraph reads, "Since these formulæ contains the velocity only in its square, they are independent of the direction of the motion, *and hold, therefore, as well for to-and-fro oscillations as for propagation of the longitudinal waves of sound.* On this depend the apparent attractions and repulsions in air when sounding and in the ribbed dust-figures of Kundt." The German of the lines which I have underscored is, "*gelten also auch für hin und her gehende Schwingungen, wie sie bei der Fortpflanzung der longitudinalen Schallwellen auftreten?*"

From § 38, on thermal effusion, "Just as effusion results from a difference of pressure at the two sides of a porous partition, so can a similar phenomenon be brought about by a difference of temperature of the two sides of a partition; and the latter phenomenon, according to Maxwell's suggestion, is called thermal effusion.

"The possibility of in this way producing a flow of gas by means of an unequal distribution of temperature, was first pointed out by Carl Neumann when he was attempting to explain the production of a thermo-electric current by analogy with a thermal diffusion."

CHAPTER IV.—*Ideal and Actual Gases.*

"From numerous observations which Galitzine has partly made by himself and partly drawn from other sources, the pressure of a mixture [of gases] is sometimes greater and sometimes less than the sum of the pressures exerted by the components separately" (p. 92). § 47 deals very briefly with attempts to improve upon the formula of van der Waals's.

CHAPTER V.—*Molecular and Atomic Energy.*

"That monatomic gaseous molecules also may be capable of oscillatory motions in their interior we may look upon as probable, since in their spectra whole series of different lines are found. But these motions, as we may assume in accordance with E. Wiedemann's observations, require so small an expenditure of energy that its amount does not come at all into account in comparison with the kinetic energy of the molecular motion.

"Hence monatomic molecules need in no way be rigid massive points; it is only necessary that they should be very small particles in whose interior only such motions can come into play as demand but very little energy. It therefore does not appear impossible that the ratio $C \div c = 1.67$ should be found in the case of chemically compound molecules also, if the connection of the atoms is so firm that internal motions are excluded" (p. 121).

The last quotation brings us near a very active crater of debate, the eruptions of which have been familiar to readers of English scientific periodicals for years; namely, the question of equal distribution of energy among the different degrees of freedom of a system. Into the general question Meyer does not go, but insists, as in his first edition, that, with such limited freedom as the atoms have within the molecule, the law of uniform distribution of energy among the various degrees of freedom

does not generally hold. "We shall be inclined to consider the rule, that *in gases with polyatomic molecules the mean energy of an atom is smaller than the translatory energy of a molecule*, to be a veritable law of nature, which, like Boyle's and the other laws of gases, admits exceptions under certain circumstances" (p. 130). "Since the bonds of the atoms by which they are bound together in the molecule allow of neither perfect freedom nor perfect fastness, it does not seem admissible simply to count the kinds of movability" (p. 144).

CHAPTER VI.—*Molecular Free Paths.*

There is little new except in § 71, where the various hypotheses to account for the observed relations between temperature and mean free path are stated and that of Sutherland is discussed at some length.

CHAPTER VII.—*Viscosity.*

We find (p. 187) "From these measures [by Crookes] it resulted that Maxwell's law of the constancy of the coefficient of viscosity in actual gases holds down to pressures which are so small that they can no longer be measured with accuracy. Only at a much higher rarefaction there occurs a sudden drop in the value of the coefficient of viscosity." "Just as at very low pressures, so also at very high pressures, Maxwell's law of the constancy of viscosity-coefficient loses its strict validity." A slightly smaller value of the coefficient is now given than the one stated in the first edition.

"By the entrance of more atoms into the molecule the section $\pi s^2$ will in most cases increase, while the molecular speed will diminish; the interval $T$ between successive collisions may therefore be constant. In this case the coefficient of viscosity must also be constant" * * * "Hence all gaseous substances which contain a large number of atoms in their molecule have nearly equal coefficients of viscosity" (p. 200).

§ 80, on viscosity of gaseous mixtures, deduces from theory a formula which is followed by this passage: "Puluj has made measurements of the internal friction of mixtures of carbonic acid and hydrogen, has compared his results with the formula, and has found a really good agreement. So, too, has Breitenbach. By these observations a striking fact was confirmed, which was first noticed by Graham as he allowed mixtures of hydrogen with other gases to flow through capillary tubes. Although the viscosity of hydrogen is less than that of carbonic acid, a slight admixture of hydrogen has the effect of increasing and not of decreasing the viscosity of carbonic acid; nor does a diminution begin until the mixture contains a largish amount of hydrogen."

In § 85, on the influence of temperature on viscosity, the views of Sutherland in regard to the effects of molecular attraction are again made prominent. "The reasons for the assumption that the sphere of action [of the molecule] diminishes as the temperature rises have been given." * * * "But in the question of actual gases, those attempts at explanation will certainly meet with most acceptance which do not assume a real diminution of the molecules or their spheres of action, but only an apparent alteration. From this point of view Sutherland's view deserves to be preferred to all others. According to him we have not to deal with the real sphere of action [that is, the sphere of which the radius is the smallest distance apart of the centres of the particles at the moment of collision], but with an apparent sphere which is [owing to intermolecular attraction] larger than the real one." "The amount of this enlargement depends on the speed with which the particles move, and, therefore, on the temperature of the gas; it is the greater the less the speed or the lower the temperature." "In bringing forward this hypothesis to explain the phenomena Sutherland had really the greatest success."

§§ 86–92, dealing with the viscosity of vapors and with viscosity as affected by dissociation, are made up of matter which did not appear in the first edition. They contain, perhaps, nothing more striking than the fact that condensation, occurring when a vapor, originally saturated, flows with some expansion through a small tube, makes the coefficient of viscosity, as estimated from rate of delivery, smaller than if the vapor were dry.

CHAPTER VIII.—*Diffusion.*

This chapter differs from the corresponding part of the first edition mainly by the

introduction of Sutherland's use of molecular attractions and by a more detailed effort of the author to justify, from experimental results, his own contention that the coefficient of diffusion of two gases is variable with the proportions of the mixture. "$D$ therefore assumes a different value at every different place in the mixture that is being formed by the diffusion" (p. 262). He admits that his own formula for $D$ makes the calculation of diffusion 'excessively laborious,' and is charitable to those who have preferred to use a more convenient though, as he maintains, inaccurate one.

CHAPTER IX.—*Conduction of Heat.*

In his first edition the author derives from theoretical considerations the formula

$$k = 1.530\ \eta c,$$

where $k$ is the thermal conductivity, $\eta$ the coefficient of viscosity, and $c$ the specific heat at constant volume. He now finds 1.6027 instead of 1.530. Other changes are indicated by the following quotations: "In fact, the assumption has many times been made, especially by Stefan and Boltzmann, that the kinetic energy of the molecular motion is passed on from place to place with greater speed than the remaining energy, which in Chapter V. we have termed the atomic energy. We were at that time obliged to yield to this view, because no other possibility was seen of bringing the theoretical law $k = \kappa\eta c$ into a complete agreement with the observations then published" (p. 284). But now, "The excellent agreement of the calculated and observed values" * * * "justifies in us, on the contrary, the conviction that the accuracy of the theoretically deduced relation between the conductivity and viscosity of gases is no longer to be doubted, and that we may take it as proved that a gas has the same conductivity for every kind of energy. From this result of theory we see finally that viscosity, diffusion, and conduction of gases depend in the same way on the free path of the gaseous particles, and that each of these three phenomena may be employed to determine the value of the molecular free path" (p. 296).

CHAPTER X.—*Direct Properties of Molecules.*

§§ 111 and 112 of this chapter carry further than the old edition does the argument in proof of the general flatness of molecules. "These examples seem to indicate that the section of a molecule is equal to the sum of the sections of the atoms which form it" (p. 302). "If the hypothesis were general and exact that the section of the molecule of a chemical compound is equal to the sum of the sections of its atoms, it would allow of but a *single* interpretation, and thereby permit an interesting peep into the circumstances of arrangement of the atoms. We should not be at liberty to make any other assumption than that the atoms which are bound together into one molecule are all in one plane" (p. 304). "When four atoms are joined together to form a molecule it is in general no longer necessary for them to possess the property of being a plane system; the possibility, however, of the system being of such a character is shown by the example of ammonia." * * * "We shall consequently be unable to make any other supposition as to the molecular constitution of ammonia than that usual with chemists, viz, that the three atoms of hydrogen are so arranged that their common centroid is always within the atom of nitrogen, and that they circle about this atom in plane orbits" (p. 305). "And so good an agreement is exhibited by the great majority of the values at 0° for gases and vapors that we have to conclude in general that *their molecules have a shape that is flat, and not spread out on all sides into space.* This view seems to be the most probable, at least for the gaseous state" (p. 309).

The last paragraph of § 116 reads thus: "From these considerations we can conclude only that the gaseous molecules are smaller than a sphere whose diameter is one-millionth of a millimetre. But we may add as very probable that the size of the gaseous molecules will in no way appear to be vanishingly small when compared with that small sphere. This is justified on many other grounds, which we have still to mention."

§ 118, on calculation of the size of the molecules from the dielectic capacity, is new. "The molecules of such substances [dielectrics] are

assumed to be good conductors of electricity, while the interspaces between them are taken to be insulating. According to this assumption the dielectric polarisation must depend on the size and distance apart of the molecules, and therefore on the same elements which regulate the molecular free path" (p. 327).

§ 123, on molecular forces, makes near the end a more detailed reference to the work of E. Wiedemann on luminous vapors. "He compared the light radiated by sodium vapor with that coming from a platinum wire made to glow by the passage of an electric current; from the resistance of the wire and the strength of the current he could determine the luminous energy in heat units, and compare it with the total heat-energy contained in the vapor. He found that the energy needed for the illumination is vanishingly small in comparison with the total energy. An atom, therefore, must be a structure in which pendulous movements can be produced by very small forces."

§ 124 is an enthusiastic statement of the general features and possibilities of the vortex atom theory. It is probable that Meyer has never seen the letter written by Lord Kelvin to the late Professor Holman, which ends thus: "We may expect that the time will come when we shall understand the nature of an atom. With great regret I abandon the idea that a mere configuration of motion suffices."

This brings us to the mathematical appendices, which extend through 112 pages. The new matter in these is, for the most part, closely connected with the changes already noted in the earlier portions of the book. In several cases the changes in numerical values of important constants are based on the computations of Conrau.

The translation is well done, though an occasional awkward phrase may show that the translator's ear for English is slightly and temporarily dulled by attention to the original. Thus, on p. 264, 'much too little for there to be found in it,' on p. 270 'has concluded the law,' and on p. 250 'relation' * * * 'which' * * * 'did not succeed in disclosing itself with full clearness.'

Edwin H. Hall.

Cambridge, Mass.

*The Digestibility of American Feeding Stuffs.* By Whitman H. Jordan and Frank H. Hall. U. S. Department of Agricultural, Office of Experiment Station, Bulletin No. 77. Pp. 100.

Since farm animals, like man, live not upon what they eat but upon what they digest and assimilate, data on the digestibility of the various feeding stuffs are essential for judging of their relative feeding value and for calculating rations for animals under different conditions. Experiments on this subject have formed quite a feature of the work of a number of the agricultural experiment stations of this country, and these experiments have accumulated until at present they furnish a comprehensive series of digestion coefficients. The Bulletin brings together the results of these digestion experiments up to the end of 1898, and summarizes them in convenient form for use. Of the 378 experiments compiled, many of which were made with a number of animals, 59 were with green fodders (grasses and corn), 34 with silage (largely of corn), 143 with dried fodders (hay, corn fodder, etc.), 8 with roots and tubers, 24 with grains and seeds, 62 with by-products (brans, gluten feeds or meal, oil meals, etc.), 1 with milk, and 47 with mixed rations. The digestion coefficients are first arranged according to the stations at which the experiments were made. They are then grouped by classes of feeding stuffs and by the kind of animal (cow, steer, sheep, pig or horse) used in making the experiment. The latter classification gives both the individual experiments and the averages for the different classes of material. It is therefore the one which will be most generally used in practice. In the light of the data presented, the effects of various factors on digestibility are considered at some length. Under this heading are included the influence of the kind and condition of the animal used, the stage of growth of the crops, the effect of drying and curing, ensiling, grinding, cooking and moistening of the feed, etc. In many cases the need of more extended data is evident before deductions can be safely drawn.

The general methods of conducting digestion experiments are described and discussed, together with the limitations of the present

methods, and the application of digestion coefficients in practice.

The compilation represents a large amount of painstaking work and study on the part of its authors, but it was well worth the undertaking and will prove a valuable summary. It will make it possible to use American digestion coefficients quite generally, in place of the European ones which were for many years the main reliance. The compilation will also serve a useful purpose in showing the lines in which additional digestion experiments are needed to supplement the data already obtained, and in calling attention to feeding stuffs which have not been sufficiently studied as to their digestibility.

E. W. ALLEN.

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## *SOCIETIES AND ACADEMIES.*

### NEW YORK ACADEMY OF SCIENCES.

### SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

A MEETING of the Section was held on Monday evening May 7th. Mr. Bergen Davis read a paper describing some new experiments in stationary sound waves. The experiments were in three groups, those with a sound wave anemometer, those with the use of empty gelatine medicine capsules instead of cork-dust to show the Kundt figures, and those concerning the longitudinal motion of a cylinder closed at one end across the stream lines in a stationary sound wave.

The stationary sound wave was that produced in a stopped organ pipe, provided with a glass panel for observation, when it was sounding its first overtone. A thin rubber diaphragm near the central node prevented air currents due to the blowing of the pipe. The cups of the miniature anemometer were made by dividing No. 2 gelatine capsules longitudinally so as to form half cylinders and mounting them on card-board arms. The anemometer rotated with ten revolutions per second in the loop of the wave and came nearly to rest in the node. The rate of revolution at various positions along the wave varied approximately according to a sine curve. The maximum amplitude of the wave as calculated from the above rate was .57 cm.

The Kundt's figure experiment was performed by emptying a box of No. 5 gelatine capsules into the middle of the loop. They arranged themselves in rows across the pipe. Each capsule attracted its neighbor at the ends and repelled it at the sides. The experiment is quite striking.

The motion of a cylinder perpendicularly to the stream lines was obtained by using a capsule from which the cap had been removed. Such a capsule moved in the direction of the closed end with considerable force. This was also shown by making a small mill with a capsule at the end of each of four card-board arms. The rates of revolution in various parts of the wave made, when plotted, nearly a sine curve. The force acting normally to the closed ends of the cylinders was measured with a torsion balance. The square roots of the torsion deflections gave, when plotted, an approximate sine curve. The experiment was performed in air, illuminating gas, carbon dioxide and hydrogen. The torsion deflections were directly proportional to the densities of the gases. Professor William Hallock first suggested the cause of this effect, showing that it was due to the principle of Bernouilli, that a gas in motion is less dense than the same gas at rest. The vibrating air has considerable velocity while the air within the cylinders is nearly at rest. The force is due to the difference of density on the two sides of the closed end of the cylinder. The author used this principle to determine the amplitude of vibration. Professor R. S. Woodward assisted him in applying the proper hydrodynamical principles, and he calculated that the change in density was such as to give a pressure of 21 dynes per square centimeter, while the amplitude was .33 centimeters. This agrees closely with the value obtained with the sound wave anemometer.

Professor Hallock also exhibited some color photographs and some sound wave photographs taken by Professor R. W. Wood, of the University of Wisconsin.

WILLIAM S. DAY,
*Secretary of Section.*

### SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

A REGULAR meeting of the Section was held on May 28th. The first paper, by G. B. Ger-

mann, on 'The Acquirement of Motor Habits' reported some experiments in which the author measured the degree of perfection attained in rapid naming of one hundred color squares arranged in regular order, by the time required to read the whole series. Results were presented for the rapidity of reading at different stages of practice and after different intervals of discontinuance of practice.

The second paper, by C. H. Judd, was on the subject 'Studies in Vocal Expression.' This paper reported measurements of changes in pitch during the articulation of single words. The pitch was determined by means of enlarged records of diaphragm vibrations which were compared with the tracing made from a standard tuning fork. Twenty records were reported. In general the accented syllable was higher in pitch than the unaccented syllables, though this was not true in such words as 'abhorrent' and 'abnormal.' The final syllable in the twenty records showed a very general tendency to fall off in pitch. The amount of change in such words as 'educing' and 'illusion' will appear from some cases of the former. The three syllables were as follows: case I., 161, 244, 171 (the end of the syllable being at 131); case II., 157, 255, 185 (end of syllable 125); case III., 172, 248, 166 (end of syllable 123). Other records did not show such marked changes. One for the word 'abasement' is as follows: 103, 150, 140.

Charles H. Judd,
*Secretary.*

## THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

The June meeting of the New York Section of the American Chemical Society was held on the 8th inst., at the Chemists' Club.

The retiring chairman, Dr. Chas. F. McKenna, invited the president of the Society, Dr. William McMurtrie, to preside. An address was made by Dr. McKenna on the 'Advancement in the Study of the Properties of the Metals,' and on the 'Present and Future of the New York Section of the American Chemical Society.'

The election of officers for the ensuing year resulted as follows:

*Chairman*, Dr. C. A. Doremus.
*Secretary and Treasurer*, Durand Woodman.
*Executive Committee*, C. F. McKenna, M. T. Bogert, P. C. McIlhiney.

The following papers were then read:

'Comparison of Iodine and Bromine Figures of Various Fatty Oils,' by H. T. Vulté and Lily Logan.

'The Chemistry of Materials used in Perfumery and kindred Arts,' by T. C. Stearns.

'Rapid Method for Separation of Cadmium, Bismuth, etc., from Zinc and Manganese,' by George C. Stone.

'On the Oxidation of Platinum,' by Dr. R. C. Hall.

A motion was made and seconded that a fund should be raised for a prize for the best paper read before the Society during each season. This was in pursuance of a suggestion made by the chairman in his address.

Notice was given of the general meeting of the American Chemical Society, to be held in the latter part of the month, after which the Section adjourned.

Durand Woodman,
*Secretary.*

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## *DISCUSSION AND CORRESPONDENCE.*

### PREHISTORIC REMAINS IN JAPAN.

To the Editor of Science: While in Okayama, Japan, in the early part of this month I was conducted by Rev. J. H. Pettee to the hills about two miles east of the city to see some prehistoric stone structures which he had noticed in his rambles. The first one to which we came was situated about 500 feet above the valley (which was nearly at sea level) near the summit of a steep declivity overlooking an extensive country. This was built of stones laid up in regular courses, some of them very large. One stone was 5x5x4½ feet. Large flat stones served for the roof. The entrance was twenty-one feet long, six feet wide and about twelve feet high. This opened into a room twelve feet long, of which the north side was flush with one of the walls of the entrance, making the entire length of this wall thirty-three feet. The room is twelve feet square, and about the same height.

The whole was covered with a mound of earth, upon which trees of considerable size were growing. This one had been cleaned out

and put to some modern use. But the eight others which we visited, were in most cases partly or wholly filled with débris which had slowly accumulated in them. In size they differed greatly from one another, several of them were so small that they could not have served for habitations. When they occurred on the side hill they were covered with earth removed from the immediate vicinity. In the roofs of two of them we measured stones which were 9x7x3 and 10x5x4 feet respectively. In all, Mr. Pettee had found twenty of these structures in the immediate vicinity. It is hoped that more careful exploration will be made of those which are filled with débris. The present inhabitants have no knowledge of their origin, and they are entirely out of analogy with any structures of recent times.

In a communication made to the Japanese Asiatic Society of London, a few years ago (the date of which I do not remember) the writer spoke of having noted about four hundred such structures in different parts of the Empire, all substantially alike, but with minor modifications in shape, only a small portion of them having the wall of the entrance and the room flush on one side, like the one here observed. The few ornaments found in them were unlike anything of present Japanese manufacture.

At Yokohama, also, I was taken by Rev. Henry Loomis to see various rooms artificially excavated in the soft rock of the region which were evidently of ancient origin, as evinced by the character of the tool marks upon them. But more interesting still were two shell heaps, about one hundred and fifty feet above the bay, in which not only had most of the shells been artificially opened to procure the food, but there were numerous pieces of pottery of antique character. The situation of these was much the same as of those described by Professor Morse near Tokio.

The universality of such indications of a primitive culture preceding that of existing civilizations in Japanese as well as in Europe and America is certainly interesting and significant. Much further light is still in store from their systematic study.

G. FREDERICK WRIGHT.

NAGASAKI, JAPAN, April 23, 1900.

## SEALS IN THE AMAZON DRAINAGE.

ON September 20, 1899, William J. Gerhard, a field entomologist, observed several seals in a stream among the headwaters of the Madiera river, in Bolivia. The exact locality was a small tributary of the Rio Secure, whose waters find their way into the Madiera by way of the Mamore river. From the position assumed by the seals, as described by Mr. Gerhard, it is evident they were members of the Otaridæ, and most probably either *Otaria jubata* or *Arctocephalus australis*.

This is, I believe, the first notice of any seal from the Amazon system.

JAMES A. G. REHN.

ACADEMY OF NATURAL SCIENCES,
PHILADELPHIA.

## THE INTERNATIONAL CONGRESSES OF METEOROLOGY AND AËRONAUTICS AT PARIS.

TO THE EDITOR OF SCIENCE: As some of your readers may be planning to attend the International Congresses of Meteorology and Aëronautics this summer, at Paris, it seems proper for the official delegate of the United States to call attention to an error in the dates announced in SCIENCE of June 1st. These congresses will not meet during July but during September, the Meteorological Congress being held between the tenth and the sixteenth of that month and the Aëronautical Congress, fixed for nearly the same time on account of the allied interests, having its sessions from the fifteenth to the twentieth of September.

The mistake, which was made also by your English contemporary, *Nature*, probably arose from the fact that when the list of the various congresses was issued several months since, the dates of the two congresses in question had not been determined; nevertheless the blanks left in the date column were assumed to mean that each of these congresses coincided with the one immediately preceding it in alphabetical order.

A. LAWRENCE ROTCH.

BLUE HILL METEOROLOGICAL OBSERVATORY.
June 7, 1900.

## THE NAME OF THE COCHINEAL.

I HAVE elsewhere (*Proc. Acad. Nat. Sci.*, Phila., 1899, p. 261) shown that the *Coccus cacti*,

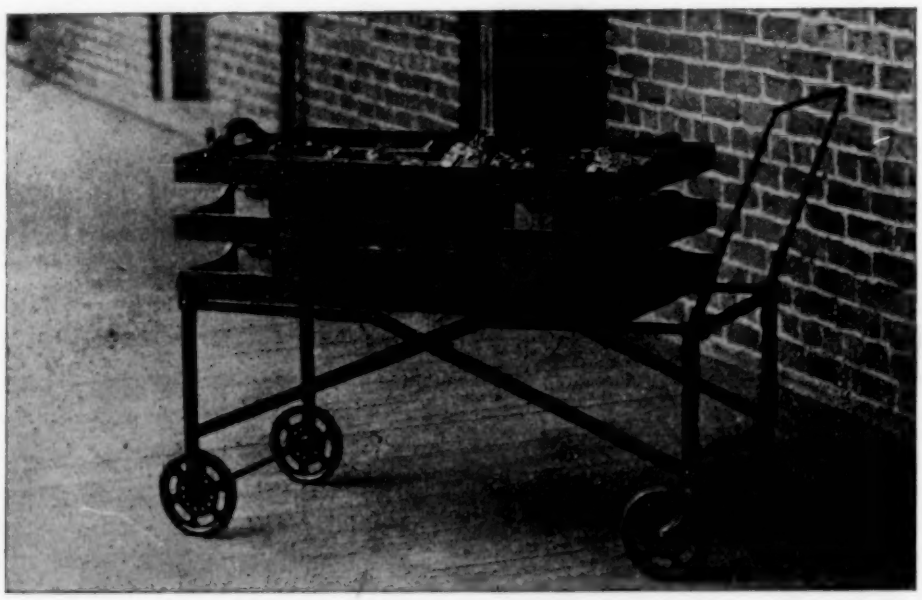
Linné, is not the true cochineal, and that the latter insect belongs to the genus *Pseudococcus*, Westwood. I have lately had some correspondence with Professor and Mrs. Fernald of the Massachusetts Agricultural College, on the synonymy of this insect, and it seems that the only way to avoid confusion is to propose a new name for the *Coccus cacti* of Signoret, Essai sur les Cochenilles, p. 381; Newstead, *Ent. Mo. Mag.*, April, 1897, p. 76. It is therefore proposed to name the latter species *Pseudococcus signoreti.*

T. D. A. Cockerell.

Mesilla Park, N. M., May 28, 1900.

### A TRUCK FOR MINERALS.

To the Editor of Science: For the benefit of those teachers who have to move heavy specimens for purposes of illustration from museum to lecture room, I send you an account of a plan which for two years I have used here with great comfort to myself. For a truck I have a folding steel church truck, such as is used by funeral directors. This, when not in use, can be folded up and put aside, occupying very little space. For convenience I have attached a handle to one end, made by bending a piece of half inch iron rod twice at right angles, and bolting the two ends to the frame, with a locking device which holds it rigid when pushed against. The minerals or other specimens are placed in shallow wooden trays 18 x 36 inches, with the usual hand holes at the ends, and set upon the opened truck. If more than one tray full be needed, others may be added by using wooden bridges, made by nailing to each end of a thin strip a little longer than the width of the tray, a square block notched below to fit the side of the tray. This contrivance makes a temporary frame on which the second tray rests securely, high enough above the first to be out of the way of the specimens. With another pair of bridges another tray can be added, and so on till the load is complete. One load of these on the truck trays is shown in the figure. The steel trucks are very strong and are guaranteed to sustain a weight of 500 pounds. They are provided with rubber-tired, ball-bearing wheels—those at one end being swiveled, and with full load they are very easily pushed or pulled and guided around the ends of cases. With an arrangement for holding books, trucks of this kind would certainly be a great convenience to librarians also.



Eugene A. Smith.

University, Ala., May 26, 1900.

### THE ECLIPSE OF MAY 28TH.

The party from Vassar College selected Wadesboro, N. C., as the station of observation for the solar eclipse of May 28th, because of its favorable weather prognostication, and because other parties having a large and varied equipment were stationed there. The instruments used by us were a three-inch Clark telescope,

and a pair of field glasses of two inches aperture, with a direct-vision spectroscope attached to one eye-piece. The three-inch telescope was to be used in comparing the color of the prominences. With this purpose in view, a low power was employed, so that the entire rim of the hidden sun could be seen at once. Cross wires at focus served for locating the prominences in position angle. Tachini and a few others have seen what appeared to be white prominences. Whether this was a real phenomenon or a psychological effect has been questioned, and among the twelve observations proposed by the eclipse committee of the Astronomical and Astrophysical Society, one upon prominence color was included, in order that a general effort to note color might lead to more definite conclusions. Purkinje's investigations have shown that the brightest prominences should look the reddest. Therefore, slight variations in redness would not necessarily indicate difference in constitution. Miss Furness is familiar with the appearance of a prominence as seen in the hydrogen line of the spectrum. She noted no marked difference in color in the several prominences seen around the sun's limb during eclipse. A variation toward the pink was clearly observable in one small prominence in the S. E. quadrant. A very large and beautiful prominence in the form of the banyan tree was observed in the S. W. quadrant. This was of the usual red color.

The direct vision spectroscope attached to the field-glass was a McClean star spectroscope, with the cylindrical lens removed. The object in view was to examine the distribution of coronium. It has been claimed that the green line of coronium is as plainly discernible in the rifts of the corona as in the streamers. With the simple apparatus above described (first suggested by Mr. Maunder) if it is properly adjusted, and if the continuous spectrum of the inner corona is not too bright, the question of distribution might be well tested. If the coronium is confined to the regions determined by the visible outline of the corona, the green image in the one glass would correspond in form to the composite image in the other. If, on the contrary, the coronium is equally distributed in streamers and rifts, the green image would indicate this by its uniformity of outline. Our apparatus was tested by examining an opening of the form of the corona, cut in cardboard, and held before a Bunsen flame, emitting sodium and lithium light. The red and yellow images were sharply defined.

The observation during totality was, however, without decided result. The continuous spectrum of the inner corona was so bright that the green image could not be separated from it. Clear separation being found impossible, attention was turned to the regions above and below the continuous spectrum limits, to note, if possible, any green extensions. These could not be seen, though the brightness of the field might have rendered this doubtful in any case. Probably the dispersion of the prisms was insufficient. The inner corona was much more brilliant than I had expected.

MARY W. WHITNEY.

VASSAR COLLEGE.

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## *NOTES ON INORGANIC CHEMISTRY.*

AT the recent meeting of the Iron and Steel Institute of Great Britain a number of very interesting papers were read, which are abstracted in *Nature* and from which we make note of the following:

A paper by Mr. B. Talbot on the open-hearth continuous steel process as introduced in the Pencoyd Steel Works in Pennsylvania. Here a basic tilting furnace of seventy-five tons capacity is used, and is charged at once with fluid metal, at a great saving of fuel and time. The general advantages of the furnace were stated to be increased output, increased yield, saving in repair, and saving in labor. A long discussion followed the paper and the opinion was general that this process represented an important advance in open-hearth steel practice.

A description was given by Mr. A. Greiner of the first blowing-engine worked by blast-furnace gas. This is a 600 H. P. engine at the Cockerill works, Belgium, and has been running since last November with unpurified gases from the Seraing blast furnace.

Mr. C. von Schwarz discussed the manufacture of cement from blast-furnace slag. Various attempts at the utilization of the slag

in the past have met with little success, but now a method has been devised and is in use in Germany and Belgium whereby the cement manufactured commands a higher price in the market than ordinary Portland cement.

An apparatus for equalizing the temperature of the hot blasts was described by Mr. L. F. Gjers and Mr. J. H. Harrison. Instead of the blast going directly from the stoves to the tuyers, whereby the temperature falls continuously from the turning on of one stove until a fresh stove is used, the blast passes from the stove through another small stove filled with checker work, and while entering on one side with varying temperature, it leaves the small stove at an even mean temperature.

The affairs of the Institute were shown to be in a very flourishing condition, 110 members being added during the year. The Bessemer gold medal for 1900 was presented to M. Henri de Wendel, the eminent French metallurgist, in recognition of his services to metallurgy in developing the iron ore resources of French and German Lorraine.

Mr. Andrew Carnegie announced his intention of founding a scholarship in connection with the Institute, for the advancement of research in connection with iron and steel.

THE same number of *Nature* gives an account of the Royal Society Converzazione of May 9th, but there appear to have been few exhibits in the line of chemistry. Professor W. A. Shenstone showed a quantity of crude non-splintering silica for use in apparatus of silica, recently described in these NOTES, and also several rods, tubes, a Giessler tube and a mercury thermometer of silica. Dr. Thorpe exhibited some examples of leadless glazed ware, and Mr. H. B. Hartley and Mr. H. L. Bowman gave a demonstration of the properties of crystals yielding double-refracting liquids on fusion. These substances, among which are para-azoxyanisol, para-azoxyphenetol, and cholesteryl benzoate, when fused give liquids which possess the properties of double refraction and dichroism, although the evidence of their elasticity, viscosity, and dielectric capacity shows them to be undoubtedly liquids.

APROPOS of Professor Shenstone's work on fused quartz a paper has appeared in the *Proceedings* of the Royal Dublin Society, by Professor J. Joly, on the 'Theory of the Formation of Silicates in Igneous Rocks,' in which he discusses the temperature range of the viscosity of quartz. He finds that when heated to 800° quartz becomes plastic and that as high as 1500° it is a thick liquid. This softening point is much lower than is commonly supposed, and makes it easier to understand the facility with which it is worked by Professor Shenstone. At the same time it lends more encouragement to the hope of a wide use of quartz for apparatus.

No little comment has been occasioned, especially in England, by the publication in the *Zeitschrift für angewandte Chemie* of a lecture delivered before the German Emperor by Professor Bredt. The title of the lecture was 'Technical Education and the Importance of Scientific Training,' and statistics were given of the three great dye-stuff factories of Germany. From these it appears that the Badische Anilin- und Sodafabrik, of Ludwigshafen, employs 6207 workmen, including 146 chemists and 75 engineers. The Farbewerke vorm. Meister Lucius und Brüning of Höchst am Main and the Farbenfabriken vorm. Fr. Bayer & Co., of Elberfeld, each employ 130 chemists. With these facts before one, it is not difficult to understand that Germany leads the world in dye stuffs.

J. L. H.

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## *NOTES ON PHYSICS.*

### THE FREEZING POINT OF WATER AND PRESSURE.

IN the *Annalen der Physik* for May, 1900, G. Tammann describes some remarkable experimental studies of the variation of the freezing-point of water with pressure. It appears that that there are three kinds of ice differing from each other in crystalline structure. Counting these three kinds of ice, five forms of water are now known, namely, vapor, liquid, ice I. (common ice), ice II., and ice III. A given pair of these forms (phases) of water can exist together in equilibrium only at definite temperatures and pressures. That is, for a given temperature the pressure at which two phases may coexist is definite. Thus ice I. and water coexist at 0°C. under atmospheric pressure, at —3°.7C. under 500 atmospheres, at —8°.4C. under 1000

atmospheres, etc. These pairs of temperatures and pressures represented by ordinates and abscissas determine a curve. This curve is called the *transition curve* (umwandlungs curve) for water and ice. Herr Tammann has followed the transition curve for water and ordinary ice far beyond the region previously known, in fact throughout its entire extent, and he has determined portions of the transition curves of water and ice II., of water and ice III., of ice I. and ice II., and of ice I. and ice III. He has also determined the latent heats of fusion of ice II. and of ice III., the latent heats of transition from ice I. to ice II. and from ice I. to ice III., and the changes of volume during these various transitions.

READERS of SCIENCE who are not familiar with recent work in physical chemistry may be interested to know that many solid substances are known which have two or more forms (phases). Thus, very recently, it has been found that metallic tin may exist as a gray crystalline powder or in the well known form having lustre and ductility. At a certain temperature (under atmospheric pressure) these two phases may coexist in equilibrium, at higher temperatures the ductile variety only is stable, and at lower temperatures the gray crystalline form only is stable.

## SOME EXPERIMENTS WITH POLARIZED LIGHT.

THE *Annalen der Physik* for May, 1900, contains a description by N. Vmow of several beautiful and instructive experiments with polarized light.

A polished cone of glass stands upon a flat white screen. A beam of ordinary light parallel to the axis of the cone is reflected by the curved surface of the cone forming a circle of light around the base of the cone upon the white screen. If the beam of light is plane polarized the circle of light will have a broad dark streak across it. If a quartz plate is placed in the path of the plane polarized beam the planes of polarization of the various wavelengths will be differently turned and the circle of light around the base of the cone will consist of radial bands of color in the order red, orange, yellow, green, blue, violet, purple.

A plane polarized beam of light is reflected down through milky water (obtained by mixing a small portion of an alcoholic solution of rosin with the water) contained in a glass cylinder. To a person walking around the cylinder the water would appear bright then dark then bright then dark again. The two opposite directions from which the milky water appears bright mark the plane of polarization of the beam of light. If now a quartz plate is interposed in the path of the polarized beam the planes of polarization of the various wavelengths will be differently turned and the milky water will appear to be streaked with vertical bands of color. A milky solution of sugar substituted for the water (quartz plate removed) shows a series of helical bands of color.

## ON THE SIZE AT WHICH HEAT MOVEMENTS ARE MANIFESTED IN MATTER.

IN his characteristically suggestive way Professor G. F. Fitzgerald, in *Nature*, April 26th, raises the question as to the maximum dimensions of a space in which the heat movements of a portion of a body in thermal equilibrium might deviate sensibly from the steady average which these movements show on a large scale. The heat movements of matter do not show their erratic character in a space large enough to be resolved by the microscope, but Professor Fitzgerald points out that the accompanying ether motions are much more coarse grained and may give rise to sensible phenomena; thus the so-called Brownian motions of small particles immersed in a liquid may be caused by the erratic character of heat motions in small regions. He suggests further that these erratic heat motions may have something to do with the vitality of diatoms. Indeed *it is physically possible* that a living cell may not be subjected to the second law of thermodynamics. If so, in what way would a diatom be expected to show its freedom from this law? Very likely in not being dependent upon food for the maintenance of its vitality, and the biologist may sometime show us an organism which can live in the dark without food.

W. S. F.

*WEATHER CONDITIONS IN NEW YORK CITY AT THE END OF JUNE.*

THROUGH the kindness of Professor Willis L. Moor, Chief of the Weather Bureau, we are able to give figures regarding the temperature and precipitation in New York City during next week, which will prove of interest to those attending the meeting of the Association.

The daily mean temperature since 1885 has been as follows:

| June. | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|
| 1885 | 68° | 69° | 69° | 70° | 69° | 69° | 65° |
| 1886 | 63 | 67 | 70 | 71 | 68 | 71 | 67 |
| 1887 | 70 | 71 | 70 | 73 | 72 | 77 | 79 |
| 1888 | 83 | 80 | 76 | 73 | 59 | 60 | 70 |
| 1889 | 68 | 70 | 72 | 75 | 77 | 78 | 72 |
| 1890 | 73 | 78 | 76 | 68 | 72 | 72 | 74 |
| 1891 | 71 | 76 | 81 | 64 | 68 | 69 | 66 |
| 1892 | 72 | 71 | 72 | 70 | 72 | 72 | 76 |
| 1893 | 70 | 67 | 57 | 62 | 62 | 66 | 71 |
| 1894 | 72 | 67 | 76 | 78 | 78 | 74 | 77 |
| 1895 | 72 | 72 | 68 | 64 | 68 | 72 | 71 |
| 1896 | 59 | 58 | 68 | 72 | 64 | 71 | 66 |
| 1897 | 71 | 76 | 65 | 64 | 67 | 72 | 76 |
| 1898 | 71 | 78 | 80 | 74 | 72 | 72 | 76 |
| 1899 | 75 | 72 | 74 | 74 | 72 | 68 | 70 |
| Mean | 70.5 | 71.5 | 71.6 | 70.1 | 69.3 | 70.9 | 71.7 |

The daily amount of rain in inches and hundredths has been:

| June. | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|
| 1885 | | | | | 0.58 | 0.02 | |
| 1886 | 0.04 | | *T* | | | | |
| 1887 | 0.13 | | | | | | |
| 1888 | | 0.30 | 0.49 | | 0.63 | 0.18 | *T* |
| 1889 | | *T* | 0.03 | | *T* | | *T* |
| 1890 | | | | | | | |
| 1891 | | | | | | | |
| 1892 | 0.01 | 0.36 | | 0.10 | 0.08 | | 0.23 |
| 1893 | | | 0.89 | 0.17 | *T* | | |
| 1894 | 0.01 | *T* | | *T* | | *T* | 0.06 |
| 1895 | 0.09 | 0.03 | *T* | 0.67 | 0.23 | 0.66 | 0.10 |
| 1896 | 0.66 | 0.55 | 0.19 | | 0.09 | | |
| 1897 | | | | | | *T* | 0.12 |
| 1898 | | 0.13 | | | 0.22 | *T* | |
| 1899 | *T* | 0.63 | | | 0.03 | 0.68 | |

The mean daily temperature is about 2° lower than would be the case in the third week in August, and it may be expected consequently to be considerably less hot during the day time than would be the case if the meeting were in August. The chances of rain are about the same.

*REORGANIZATION IN THE GEOLOGICAL SURVEY.*

THE geological work of the United States Survey was originally organized in grand geographic divisions for each of which there was a geologist-in-charge, having complete authority over his assistants. After many years of trial this system was found to be expensive, both of means and talent, and was replaced by the temporary expedient of a large number of independent parties reporting immediately to the director. Administratively this plan has worked very satisfactorily, but it lacked scientifically the element of co-operation between distinct parties. To effect this co-ordination of scientific results in each important specialty of geology, the following organization has now been adopted, as stated in the draft of plans for the current year, approved by the Secretary of the Interior.

Six geologists have been appointed as geologists in charge of special subjects of research, the six subjects covering the whole field of geology in the Survey. These assignments are as follows:

T. C. Chamberlin, geologist in charge of pleistocene geology; George F. Becker, geologist in charge of physical and chemical research; S. F. Emmons, geologist in charge of investigation of metalliferous ores; C. Willard Hayes, geologist in charge of investigation of non-metalliferous economic deposits; Bailey Willis (assistant in geology to the director), geologist in charge of areal geology.

These assignments are based upon the necessity for closer supervision and co-ordination of the growing geologic work of the Survey. The personnel of the geologic branch will be classed as geologists in charge, geologists, and assistant geologists. Administrative control of the two former classes shall in each individual case be immediate with the director. Assistant geologists will report through their chiefs. Scientific direction will be the duty of the geologists in charge, each in his special section, and shall be accomplished by appropriate conference in the office and supervision in the field.

The total appropriation for geologic work for 1900–1901 is $163,700. To this are added from the State of Pennsylvania $2000, and from the State of New York $1000, sums appropriated for co-operation in geology with the Federal Survey, and on condition that in each case a like amount be expended from the Federal appropriation for work in the State. The total amount available for geologic surveys is therefore $166,700.

*SCIENTIFIC NOTES AND NEWS.*

THE University of Toronto has conferred the degree of doctor of laws on Professor Simon Newcomb, U. S. N.

CAMBRIDGE UNIVERSITY proposed to confer on June 12th the degree of LL.D. on Professor S. P. Langley of the Smithsonian Institution, and on M. Poincaré, the Paris mathematician.

AMONG the honorary degrees conferred on June 14th at the commencement of the Western University of Pennsylvania, the Sc. D. was given to O. A. Leuschner, professor of astronomy, University of California, and to Wm. W. Campbell, senior astronomer, Lick Observatory.

PROFESSOR A. P. COLEMAN, of the University of Toronto, and Dr. H. M. Ami, of the paleontological staff of the Geological Survey of Canada, Ottawa, were elected Fellows of the Royal Society of Canada at its last meeting held in Ottawa, May 28–31, 1900.

PROFESSOR H. F. OSBORN, of Columbia University and the American Museum of Natural History, has been invited to succeed the late Professor Cope as vertebrate paleontologist of the Geological Survey of Canada.

WE regret to learn that Dr. Henry Sidgwick, for nearly thirty years professor of moral philosophy at Cambridge University, is compelled to resign his chair owing to ill-health. Professor Sidgwick is at present sixty-two years of age and is well known as one of the greatest English writers on ethics and political science.

ON May 3d the completion of the twenty-fifth year of teaching by Professor Luciani, rector of the University of Rome, was celebrated in the physiological laboratory of the university. Addresses were made by Professors Todaro and Baccelli and Professor Luciani replied.

PROFESSOR IRA REMSEN, of the Johns Hopkins University, will give the commencement address at the Tome Institute, Port Deposit, Md.

SPECIAL preparations are being made in the American Museum of Natural History for the reception of members of the American Association. President Jesup has issued an invitation to all the local members for Tuesday evening, June 26th, and a similar invitation will be mailed to visiting members immediately upon their registration. Members will be admitted on the closed days, Monday and Tuesday, upon showing their tickets or badges. The curators will be ready to assist in showing the various exhibits. The newest hall is that of Mexican archæology under the direction of Professor J. W. Putnam and Mr. Saville. The Fossil Mammal Hall has recently received a large number of additions, both in fossil mammals and reptiles. A full series of photographs of the museum has recently been made, and will be placed on exhibition in the lower hall.

THE Society for Plant Morphology and Physiology is to hold a special meeting at the Museum Building, New York Botanical Garden, on Wednesday, June 27th, at 4 p. m., to receive the report of the committee (appointed in December at the New Haven meeting) upon improvement of reviews of botanical literature. The question of concerted action upon the subject with the other botanical societies will be considered.

THE Scientific Society of Danzig offers on the occasion of the 150th anniversary of its establishment, a prize of 1000 Marks for a paper on the geology of North Germany.

THE Peabody Academy of Science receives $10,000 by the will of the late Walter S. Dickson.

THE late Baron Adolphe-Charles de Rothschild bequeathed property bringing in an income of $50,000 a year for the establishment of an ophthalmological hospital at Paris. He also bequeathed his fine collection of objects of art to the Louvre with $60,000 to defray the cost of arranging them for exhibition.

THE Paris Pasteur Institute will offer in November, in its new quarters in the rue Dutot, courses of instruction including lectures, conferences and laboratory work. They will include bacteriological methods of analyzing physiological and pathological products, etc.

MR. W. E. D. SCOTT, curator of the ornithological department in Princeton, announces that the British Museum has presented to the university two thousand mounted birds, specimens from India, Australia and the Malay Islands. Some time ago the university pre-

sented the British Museum with 250 sets of North American birds' eggs.

Mr. P. M. Musser has given $30,000 for a public library at Muscatine, Ia.

The Norwegian steamer *Antarctic*, with the Danish East Greenland expedition commanded by Lieut. Amdrup, sailed from Copenhagen on June 14th, to explore the coast between Cape Brewster and Agga Island.

The *Engineering and Mining Journal* of June 9th publishes the full tables of mineral and metal production of the United States in 1899, as prepared for the *Mineral Industry*, Volume VIII. This production, valued at the mines or furnaces, amounted to $1,211,361,861, the largest amount on record for the United States or any other country. Deducting certain necessary duplications, the net value of the mineral production in 1899 was $1,118,780,830, against $799,518,033 in 1898, showing an increase last year of $319,262,797, or 39.9 per cent. This great amount came partly from the increase in quantities and partly from general advances in values. The United States last year was the greatest producer of coal, salt, iron, copper, silver and lead in the world; also of many of the less important metals and minerals. The extent of our production is shown by the figures, which include 252,115,387 short tons of coal; 13,400,735 long tons of pig iron; 581,319,091 pounds of copper; 217,085 tons of lead; 129,675 tons of zinc; 57,126,834 ounces of silver, and $70,096,021 in gold.

Movements started simultaneously in London by the Royal Geographical Society and in the British Central Africa Republic under the leadership of Sir Henry Stanley for the erection of a memorial near the spot where Livingstone died on Lake Bangweula, resulted in the formation of a joint committee for purposes of cooperation. The work of the committee as we learn from the London *Times* has now been accomplished. The materials with which to construct the memorial having been shipped to the mouth of the Zambesi. The monument consists of a handsome obelisk 20 feet in height, surmounted by a cross. It is constructed of large blocks of the best concrete, which will be quite as enduring as the hardest stone. No stone is available in this part of Africa. The concrete was sent out in air-tight metal cylinders, of which there are 450, each weighing about 50 pounds. These are accompanied by 30 moulds of oak, lined with metal, 18 inches square and about 10 inches deep. Over 300 of these blocks will be used in the construction of the memorial. Two tablets of blackened bronze will be firmly embedded in blocks as they are being moulded, and will be placed on opposite sides of the obelisk. These will contain the following inscription:

Erected by his friends to the memory of Dr. David Livingstone, missionary and explorer. He died here, May 4, 1873.

Two other tablets will be placed on the other faces of the memorial, with the following inscription:

This monument occupies the spot where formerly stood the tree at the foot of which Livingstone's heart was buried by his faithful native followers. On the trunk was carved the following inscription:—David Livingstone. Died May 4th, 1873. Chuma, Souza, Mniasere, Uchopere.

The extensive repairs on the Peary Arctic Steamer *Windward* which have been in progress for several months are now completed and the steamer will sail from Sydney about July 1st in command of Captain Samuel W. Bartlett. The New York *Evening Post* states that the *Windward* will proceed directly, with a call at Disko, to Etah, North Greenland, Captain Peary's winter quarters, where instructions from him will doubtless be found, or if not, will be awaited. It will take with her the maximum quantity of coal, additional lumber, oil, sugar, arms, ammunitions, provisions, scientific instruments and everything which is necessary for Mr. Peary's work, including two new whale-boats, built at New Bedford, for the Peary service, thoroughly equipped in every detail. Upon the arrival of the *Windward* at Etah, Mr. Peary will assume command, and further movements will be subjected to the conditions of his work and to his instructions. No passengers will be taken on the *Windward*, the Danish Government having qualified their permission to land at the Greenland ports, with conditions that tourists should not be carried.

REUTER'S AGENCY has received a letter from Major St. H. Gibbons, who is engaged on a trans-African expedition, dated 'North Moera Lake, January 21st,' in which the explorer says: "I reached the neighborhood of Nanakundundu with native canoes early in October, but failed to procure carriers to follow the route I intended to take—viz, to the Zambesi source and thence along the watershed into the Congo eastwards. Thus I was compelled to make the journey with four boys and five donkeys. After traveling thus for 420 miles, during which I lost two donkeys, who were killed by lions, I caught up the Lemaire-Katanga Scientific Expedition. I overtook Captain Lemaire near the Mumbeje river and travelled with him east to the Lufira system, and thence northeast to the Congo State station on the Lukafu river. I have been treated with the greatest cordiality by Captain Lemaire and by all the State officials with whom I have come in contact. The objects of the expedition have so far been carried out *in toto*, and I am now on my way home by forced marches *via* Lado and Khartum. From where I now am this route will probably prove as quick as *via* either the east or west coast. The main reason why, after abandoning the northern route in favor of the west on the paralyzation of the main supplies with the steamers occasioned by Mr. Muller's death and Mr. Weller's loss of health, I have again returned to the original plans laid down is that I wish to examine the country between here and the Nile for the purpose of giving Mr. Rhodes such information as may be helpful to him in connection with his railway and telegraph schemes in Africa. I continue my journey north to-morrow, and expect to reach Lado in April. Thence I shall descend the Nile as best I can."

IT is stated in the *British Medical Journal* that next autumn with the co-operation of the Mediterranean, Adriatic, and Sicilian Railway Companies, the Società per gli Studi della Malaria will make experiments on a large scale as to the prevention of malarial fever among railway servants in malarious districts in Italy. At all the stations which bear the worst name in regard to this scourge the huts in which the men and the families live will be protected with mosquito netting in the way which proved so successful last year in the Prenestina-Cervara and Magliana-Pontegalera lines. Similar experiments will be made on the Foggia-Barletta and Battipaglia-Reggio lines, on the Pontine Marshes, and in Sicily. Systematic examinations of the blood of sufferers from malaria will also be made in the hospitals of Milan and Crema, with the object of studying the course of the fever in Lombardy. Research stations will be established at Cumignano on the Naviglio in the province of Cremona for the study of malaria in its relation to rice fields, and in the province of Ferrara for the study of the disease in its relation to brackish waters and the maceration of textile plants. Another station will be established at Trinitapolis in the province of Foggia for the study of malaria in the south of Italy, and probably one in the Venetian district. Similar investigations will be pursued in Sicily and Sardinia. By this combination of research it is hoped to gain an accurate idea of the regional distribution and local characteristics of malaria in Italy, and to find means of prevention adopted to the condition of the different parts of the country.

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## *UNIVERSITY AND EDUCATIONAL NEWS.*

BY the will of Edmund Dwight $125,000 has been left to Harvard University after the death of persons who receive the income during life.

IT is said that over $900,000 have now been subscribed towards the endowment fund of Brown University, and the completion of the million dollars will probably be announced at the commencement exercises.

SOME months ago Mr. Rockefeller offered $100,000 to Denison University upon the condition that $150,000 additional be raised before July 1st of this year. At the commencement exercises, June 14th, it was announced that the required amount has been subscribed, and, in addition, enough more to bring the total of the present increase in the productive endowment up to $300,000. It was announced, at the same time, that Shepardson College for Women, also located at Granville, O., has been formally incorporated into Denison University, making the latter practically co-educational. As thus

reorganized, Denison University includes the following schools: Granville College, Shepardson College, The Conservatory of Music, The School of Fine Arts, The School of Military Science, Doane Academy.

Mr. Morris K. Jesup has given $25,000 to Princeton University for an object not specified.

Mr. R. M. Stimson has given to Marietta College his library containing about 20,000 volumes.

Mr. W. S. Stratton has given $50,000 to Colorado College.

Messrs. Phelps, Dodge & Co. have contributed $10,000 to a special fund for the endowment of the departments of mining and metallurgy at Columbia University, and smaller sums have been contributed to the same fund.

A gift of $25,000 to Lombard College in Galesburg, Ill., by William G. Waterman of Galena, Ill., and another gift of $8000 by Judge Sylvanus Wilcox of Elgin, nearly complete the $100,000 semi-centennial fund of the college.

The opening of Rochester University to women seems now practically assured, as of the $50,000 required for that purpose $40,000 have already been secured.

Lyman C. Smith, a citizen of Syracuse, and a trustee of Syracuse University, will build and equip a civil engineering building for that institution.

The department of geology, of Harvard University, offers, in connection with the work of the summer school, an advanced course in geological field-work in New York and Connecticut. The work in the corresponding course last summer was in Montana and the Yellowstone Park. The summer excursion for practical observations of mining will begin as soon after the final examinations as possible, and will last six weeks. Instead of the usual trip to the Lake Superior iron region, the tour this summer will be to the anthracite coal mines of Pennsylvania and the iron mines of the Lake Champlain district.

The degrees conferred by the University of Toronto at its recent commencement were as follows: Ph.D., 1; M.A., 17; LL.B., 2; M.B., 45; B.A., 134; C.E., 2; Mg.E., 1; Mech.E., 1; B.A.Sc., 10; D.D.S., 68; Ph.M.B., 34; Mus. Bac., 3.

At the recent meeting of the Regents of the University of Nebraska, Dr. Bessey, acting chancellor, reported the enrollment in the several colleges as follows:

| | |
|---|---|
| The Graduate School, | 148. |
| The College of Literature, Science and Arts, | 923. |
| The Industrial College, | 585. |
| The College of Law, | 161. |
| The College of Fine Arts (Schools of Art and Music), | 366. |
| Summer School, | 282. |

After deducting duplicate names, the total enrollment for the college year is 2205, of which 1229 are men and 976 women.

At the commencement exercises on June 7th, degrees were conferred as follows:

| | |
|---|---|
| Bachelor of Arts, | 89. |
| Bachelor of Science, | 34. |
| Bachelor of Law, | 65. |
| Master of Arts, | 28. |
| Doctor of Philosophy, | 1. |

Certificates of graduation from the School of Music, 9; University Teachers' Certificates, 31; Certificates in Mechanic Arts, 2; Certificates in Physical Training, 2.

At the University of Nebraska the following appointments have been made: Carl Christian Engberg, Ph.D. (Nebraska), to be instructor in mathematics. Clarence Aurelius Skinner, Ph.D. (Berlin), adjunct professor in physics, in place of Dr. Louis Trenchard More, resigned. John Edwin Almy, M.A. (Nebraska), and Ph.D. (Berlin), to be instructor in physics, in place of Dr. Skinner, promoted. Dr. John White has been advanced to the professorship of general and analytical chemistry. The twenty-five appointments to fellowships include the following:

*Botany.*—George Grant Hedgcock, William Titus Horne, Cora Frances Smith, John Lewis Sheldon.

*Electrical Engineering.*—Herbert Silas Evans.

*Geology.*—Cassius Asa Fisher, A.B.

*Mathematics.*—Louis Siff.

*Pedagogy.*—William R. Hart.

*Philosophy.*—Frederick Henry Kuhlmann.

*Zoology.*—Frank Elbert Watson.